



Durham E-Theses

Stress, attitudes and personality in computing in students (1990-1993)

Giannoutsos, Evangelos

How to cite:

Giannoutsos, Evangelos (2004) *Stress, attitudes and personality in computing in students (1990-1993)*, Durham theses, Durham University. Available at Durham E-Theses Online: <http://etheses.dur.ac.uk/4080/>

Use policy

The full-text may be used and/or reproduced, and given to third parties in any format or medium, without prior permission or charge, for personal research or study, educational, or not-for-profit purposes provided that:

- a full bibliographic reference is made to the original source
- a [link](#) is made to the metadata record in Durham E-Theses
- the full-text is not changed in any way

The full-text must not be sold in any format or medium without the formal permission of the copyright holders.

Please consult the [full Durham E-Theses policy](#) for further details.

Stress, Attitudes and Personality in Computing in students (1990-1993)

by

Evangelos Giannoutsos

**A copyright of this thesis rests
with the author. No quotation
from it should be published
without his prior written consent
and information derived from it
should be acknowledged.**

Thesis submitted to the University of Durham

Department of Psychology

for the degree of

Doctor of Philosophy



25 AUG 2004

Declaration

The research contained in this thesis was carried out by the author while a postgraduate student in the Department of Psychology at the University of Durham. None of the work contained in this thesis has been submitted in candidature for any other degree.

Due to delays outside my control, this research concerns a period of time significantly prior to first submission and final examination. Appendix 13 provides an update of current related research and places the results of the PhD thesis within this context.

Statement of copyright

The copyright of this thesis remains with the author. No quotation from it should be published without his prior written consent and information derived from it should be acknowledged.

Stress, Attitudes and Personality in Computing in students (1990-1993)

Submitted for the degree of Doctor of Philosophy

by

Evangelos Giannoutsos

Abstract

The present work was concerned with the initial attitudes of users (students) towards computers, the relation of these attitudes to prior experience, stress, performance and the personality of the individual, and the extent to which changes come about as the result of experience gained from a type of computer course. The extent to which individuals found computing stressful was investigated. Studies were conducted employing questionnaire methods to provide data, over a three year period, on three cohorts of students taking psychology practical sessions which had a computing component.

The changes of attitude in relation to experience gained from a type of computer course, as well as the effects of prior experience on initial attitudes and attitude change were studied. The main hypothesis was that computing experience would improve attitude scores. It was found that subjects with the greatest prior computer experience did indeed have more positive initial attitudes. However, attitude scores decreased over the year, in that the higher the prior experience the more the decrease.

Computer stress, the impact of computing experience on computer stress and performance, as well as their relation to computer attitude, were examined. There was only a transient effect of a computing session on experienced stress; subjects with greater prior experience and more positive attitudes towards computers had lower levels of stress before and after computer sessions. No effects of prior computer experience were found on computer performance. A series of multiple regressions indicated that the main attitudinal predictor of computer related stress was computer confidence, whereas the key predicting variable of anticipatory stress was computer anxiety.

Computer attitudes, stress, performance, and prior experience were examined in relation to the personality variables of locus of control, extraversion, neuroticism, and A typology. Two measures of Locus of Control were used and correlations suggested that internals were likely to have more positive attitude, experience lower levels of stress and perform better than externals. Higher levels of neuroticism were associated with less favourable attitude and higher levels of stress – although not with performance. Higher extraversion was associated with lower levels of computer anxiety and anticipatory stress. Finally, higher Type A scores were found to be associated mainly with more positive attitude.

A series of multiple regression models suggested that experience explains more variation in attitudes than locus of control. Another series of multiple regression models, using as independent variables attitude and personality variables together, suggested that it is mainly attitude (confidence and anxiety) that accounts for most of the variance in stress.

Results were discussed in the context of relevant literature, and the relationships between attitude and different aspects of experience as well as between attitude and personality were emphasised.

To my parents,
Yiorgos and Efthokia

Acknowledgements

First, I would like to thank a number of people who contributed to this thesis. (Any omission should be regarded as purely accidental and by no means intentional).

I would like, firstly, to express my warmest thanks to my supervisor David Kleinman not only for his practical help in writing this thesis but also for his careful guidance into research methods, measures and statistics required for this project. It was always a pleasure to work with him and his suggestions and remarks were always interesting and constructive.

I am grateful to the following people for their help: Cathy Thompson, Ala Hola, and Gordon Dooley, for providing their class time for my surveys; Professor John Findlay and Professor Steve Cooper for the use of the facilities of Durham University Psychology Department and for their support; Rosemary Stevenson and Robert Drewett for their advice; Sharon McDonald for proof reading.

Thanks to the Saripolion Institute of the University of Athens for partially financing this project.

Also, thanks to Robert Lowe for his friendship, for sharing an office with me, and for the very interesting discussions we had; and thanks to Dawn for her company.

I would like also to thank all those students who agreed to take part in my surveys, and all those members of the Psychology Department, both staff and students, who have helped to create a supportive and enjoyable working environment.

Most of all, I wish to express my gratitude and indebtedness to my parents for their financial assistance and their continuing encouragement and support.

Table of Contents

Declaration	i
Abstract	ii
Dedication	iii
Acknowledgements	iv
Table of contents	v
List of tables	viii
List of figures	x

Chapter One

1 Introduction to the Studies and Review of the Literature

1.1 Introduction	1
1.2 Early research on computer attitudes, stress and anxiety	3
1.2.1 The influence on research on computer attitudes and anxiety	3
1.2.2 Initial research on computer attitudes, anxiety and stress	5
1.2.3 Roots and origins of computer attitudes, anxiety and stress	7
1.2.4 Computer attitudes, anxiety, and their correlates	11
1.3 Computer attitudes, computer anxiety, computer stress, and computer experience	12
1.3.1 Computer attitude	12
1.3.2 Computer anxiety	15
1.3.3 Relationship between computer attitudes and computer anxiety	20
1.3.4 Relationship between attitude, anxiety, and experience	21
1.3.5 Stress and computer stress	28
1.4 Conclusions and general research questions	32

Chapter Two

Computer attitudes and the effect of computing experience

2.1 Introduction	33
2.2 Method	40
2.2.1 Subjects	40
2.2.2 Materials and measures	40
2.2.2.1 CAS Computer Attitude Scale	40
2.2.2.2 DCAS Durham Computer Attitude Scale	42
2.2.2.3 Potential correlates within DCAS	43
2.2.2.4 Code name	44
2.2.3 Procedure	44
2.3 Results	46
2.3.1 Initial computer attitudes - The CAS and the DCAS	46
2.3.2 Effects of computing experience in the practicals on attitude	47
2.3.3 Effects of experience prior to the practicals on attitude and attitude change	49
2.3.3.1 Effects of prior experience on initial attitude	50
2.3.3.2 Effects of prior experience on attitude change	52
2.3.4 Reported attitudes on DCAS	55
2.4 Discussion	58

Chapter Three

Computer stress, performance, experience, and attitude

3.1 Introduction	64
3.1.1 Introductory conceptualisation of stress in computing	64
3.1.2 Hudiburg's studies on the relation between computer attitude/anxiety and stress, and the relation between computer stress and experience	65
3.1.3 Experience as a moderator of computer stress: Dolan and Tziner's study	69

3.1.4 Stress as not a computing specific issue: Kumashiro, Kamada, and Miyake's study	70
3.1.5 Conclusions, research questions and hypotheses	73
3.2 Method	75
3.2.1 Subjects	75
3.2.2 Materials and measures	75
3.2.2.1 Stress and arousal checklist (SACL)	76
3.2.2.2 Computer tasks, difficulty, and performance	77
3.2.2.3 Subjective stress ratings	78
3.2.3 Procedure	80
3.3 Results	82
3.3.1 Changes in SACL from BEFORE to AFTER a computer session	82
3.3.2 Effects of prior computing experience on stress	83
3.3.3 Subjective ratings	86
3.3.4 Performance, (subjective) difficulty, and experience	90
3.3.4.1 Measuring performance by using the task ratings	90
3.3.4.2 Measuring subjective difficulty by using the task ratings	90
3.3.4.3 Effects of prior experience on performance and subjective difficulty	91
3.3.5 Attitudes, stress, and performance	94
3.4 Discussion	105
 Chapter Four	
Personality, and attitude/anxiety, stress and performance in computing	
4.1 Introduction	115
4.1.1 Personality and stress / anxiety	115
4.1.2 Locus of control, stress, and computer attitude	115
4.1.2.1 Locus of control	115
4.1.2.2 Studies on locus of control, and computer attitudes, stress, performance and experience	118
4.1.2.3 Summary of studies on locus of control, and computer attitude, experience, stress and performance	128
4.1.3 Type A, and stress and computing	129
4.1.3.1 Type A and stress	129
4.1.3.2 Type A in computing	131
4.1.4 Personality structure: Extraversion and Neuroticism	133
4.1.4.1 General	133
4.1.4.2 Extraversion and Neuroticism in Computing	135
4.1.5 Conclusion, research questions and aims of the study	137
4.2 Method	143
4.2.1 Subjects	143
4.2.2 Materials and measures	143
4.2.2.1 Levenson's locus of control scale	143
4.2.2.2 Spheres of control inventory (SOC)	145
4.2.2.3 The OSI (Occupational Stress Indicator)	147
4.2.2.4 The EPI (Eysenck Personality Inventory)	150
4.2.3 Procedure	150
4.3 Results	152
4.4 Discussion	173
 Chapter Five	
General Discussion	196
 References	 212

Appendices

Technical Appendix One	236
Psychometric characteristics of the Computer Attitude Scale (CAS)	
Technical Appendix Two	238
Characteristics of the Stress and Arousal Checklist (SACL)	
Appendix One	245
CAS: Computer Attitude Scale	
Appendix Two	246
DCAS: Durham Computer Attitude Scale	
Appendix Three	247
Initial and Final Instructions for the completion of CAS and DCAS - Codename	
Appendix Four	249
Stress and Arousal Checklist (SACL)	
Appendix Five	250
Lists of computer tasks for each computer practical session	
Appendix Six	255
Subjective Stress Ratings	
Appendix Seven	256
Instructions for the completion of SACL, task lists, and stress ratings	
Appendix Eight	257
Levenson's Locus of Control Questionnaire	
Appendix Nine	259
Paulus' Spheres of Control (SOC) Inventory	
Appendix Ten	260
EPI: Eysenck Personality Inventory	
Appendix Eleven	262
Type A / B subscale from the OSI (Occupational Stress Indicator)	
Appendix Twelve	263
Instructions for the completion of personality questionnaires	
Appendix Thirteen	264
A brief review of recent literature on attitudes and personality in computing	
Appendix Fourteen	282
Overview of the literature	
Appendix Fifteen	295
Overview of the present research	

List of Tables

Chapter Two

Table 2.1	Initial computer attitude scores. Means and Standard Deviations of Computer Anxiety, Computer Confidence, Computer Liking, and DCAS initial scores for each academic year of data collection separately	46
Table 2.2	Initial and final computer attitude scores. Means and Standard Deviations of Computer Anxiety, Computer Confidence, Computer Liking, and DCAS scores for each academic year separately	47
Table 2.3	Initial and final attitude scores. Means and Standard Deviations of Computer Anxiety, Computer Confidence, Computer Liking, and DCAS scores, over all three years collapsed together, and for all subjects as 'paired samples' on the two different occasions, Test 1 and Test 2	49
Table 2.4	Initial attitude scores. Means and Standard Deviations of Computer Anxiety, Computer Confidence, Computer Liking, and DCAS scores, over all three years collapsed together, for each of the four groups of computer experience (1, 2, 3, and 4) separately, and on Test 1 only	50
Table 2.5	Initial and final attitude scores. Means and Standard Deviations of Computer Anxiety, Computer Confidence, Computer Liking, and DCAS scores, over all three years collapsed together, for each of the four groups of computer experience separately, and for all subjects as 'paired samples' on the two different occasions, Test 1 and Test 2	53
Table 2.6a	Summary of the experiences which have led to particularly positive or negative feelings about using computers a) Frequencies of positive	56
& Table 2.6b	responses b) Frequencies of negative responses	& 57

Chapter Three

Table 3.1	Overall Summary of Means of STRESS scores, before and after computer session, over all three years collapsed together, and for all subjects as 'paired samples' (Note that these data are based on the same subjects before and after computer interaction)	82
Table 3.2	Means and Standard Deviations for the four experience groups collapsed across weeks	85
Table 3.3	Means of stress scores, for high computer experience users, before and after computer sessions, and for each week separately	85
Table 3.4	Frequencies of responses to subjective ratings	87
Table 3.5	Percentages for responses of agreement (subjective ratings)	88
Table 3.6	Overall Summary of Means and Standard Deviations of subjective ratings scores, as reported after computer session, over two years collapsed together, and for all subjects	89

Table 3.7a	Means of Performance scores for each of the four groups of computer experience and each week separately	92
Table 3.7b	Means of Subjective Difficulty scores for each of the four groups of computer experience and each week separately	92
Table 3.8	Descriptive statistics and characteristics for chapter three variables	96
Table 3.9	Correlation matrix: Pearson's Correlation Coefficients. Correlations between initial attitudes, stress before, stress after, subjective ratings, performance and subjective difficulty variables	97
Table 3.10	Multiple regression and regressions of CAS and DCAS on stress and performance dependent variables	101

Chapter Four

Table 4.1	Descriptive statistics for all personality, attitude, stress, performance and subjective difficulty variables scores	153
Table 4.2	Correlations between personality, and initial attitudes, stress, performance and subjective difficulty variables	156
Table 4.3	Multiple regressions of Locus of Control and Experience on Computer Attitudes	159
Table 4.4	Multiple regression. Dependent variable: Performance	167
Table 4.5	Multiple regression. Dependent variable: Subjective difficulty	169
Table 4.6	Multiple regression. Dependent variable: Stress before	170
Table 4.7	Multiple regression: Dependent variable: Stress after	171
Table 4.8.	Multiple regression. Dependent variable: CPTOT	172

List of Figures

Chapter Two

- Figure 2.1 Prior experience and initial computer attitude scores 51
- Figure 2.1 Changes of Computer Attitudes (as measured by CAS and DCAS) over the academic year as a function of prior experience 54

Chapter Three

- Figure 3.1 Stress scores, for all four groups of computer experience, before and after computer sessions, for weeks 1 to 4 84

CHAPTER ONE

1 Introduction to the Studies and Review of the Literature

1.1. Introduction

Since the invention of the microprocessor in 1969 by Ted Hoff of Intel Corporation, computers have evolved from technological novelty to their present advanced stage of development. They have penetrated into everyone's life and are now recognised as powerful tools for both public services and individuals. In fact, although (micro)computers are less than thirty years old, computer technology touches virtually every area of our lives, including business, banking, health care, education, law enforcement, etc.

Misconceptions have arisen because the public understanding of computers has not always kept pace with technological advances. The science-fiction view of the computer as the villain in society has been popularised by authors, songwriters, and movie producers. This frightening view of the computer controlling our lives feeds upon a considerable misunderstanding of computer technology (Raub, 1981).

Before 1983 a few formal and various informal studies had been conducted on the nature of attitudes, especially negative, stress, and anxiety towards computers. Most of the informal studies were reported in popular business newspapers and magazines, mainly American, such as 'Business Week', 'The Wall Street Journal', and in computer industry trade papers, such as 'Computerworld'. However, the view of computer stress, attitudes, and anxiety that came out of these reports was neither very clear nor complete.

As a summary, these studies had concluded that computer anxiety and stress (also referred to as compu(ter)phobia, cyberphobia, technophobia, computer aversion, and 'terminal shock') as well as negative attitudes towards computers, occurred to some measurable degree in about one third of the office workers surveyed, and that a few people developed physical manifestations of their stress reaction (psychosomatic symptoms), such as sweaty palms, mild nausea, and increased pulse rates (Howard, 1984).

In addition, Raub (1981) found surprisingly high levels of computer anxiety and negative attitude towards computers among undergraduate university students taking a computer programming course. He concluded that computer anxiety reaction is related to the issue of 'technological alienation'. Similarly, Howard (1984) suggested that the negative attitude and anxiety towards computers was here to stay, because it seems to have, in addition to 'technological alienation' roots, other "deep psychological origins".



Weinberg (1983) argued that not only will a certain percentage of the population always be susceptible to stress problems related to computer use, but also that the incidence of negative computer attitude and anxiety will increase over time. This was because, in Weinberg's view, computers have gradually 'invaded' all types of work in all kinds of organisations, and employees, who either consciously or circumstantially avoided computer use in the past, cannot avoid them any more. However, Weinberg appeared to be quite optimistic, in that he considered computer stress and anxiety as problems reasonably easy to treat.

In addition, Weinberg (1983) felt that the increasing proliferation of computers would not reduce computer anxiety and improve attitudes by increasing computer literacy, but would increase computer anxiety and worsen attitudes as society becomes more and more computerised. This, according to Weinberg, was because increasing numbers of people in non-technical fields would eventually confront computers, and also, in Weinberg's view, there would always be a proportion of individuals (computer users or anticipating users) with an aversion to technical topics, and an inability to think in the disciplined, systematic way required for successful interaction with computers. However, this view seems to be rather old fashioned now, since modern computer interfaces have, to a certain extent, tackled this problem successfully.

On the other hand, Brosnan and Davidson's (1994) review gives an estimate that, "on average, between one quarter and one third of the population of the industrial world are technophobic to some degree" (Brosnan, 1998). As Brosnan also notes "There was an original assumption that computer anxiety would be a transitory phenomenon, common amongst older adults who had missed out upon technology in their education. These assumptions are not being borne out, with some research indicating that as computers are appearing in schools, children are getting increasingly computer anxious at an earlier age. Other research indicates that the over fifties are less anxious than the under thirties, suggesting that far from reducing anxiety, computer experience can increase anxiety levels".

Anxiety concerning the use of computers (or 'computer anxiety') has been investigated since the early eighties (Raub, 1981) and has been identified in a large range of populations from students to law enforcement officers (Marcoulides et al, 1995). A review of the literature suggests that "around one third of the individuals within most populations experience computer anxiety to some degree, ranging from a preference not to use computers through to palpitations at the thought of using computers" (Brosnan and Davidson, 1994). "This figure has been found to be as high as 50% in college students by Rosen and Maguire (1990)" (in Brosnan, 1998).

Also, computer anxiety has been described as 'a real phenomenon' (Moldafsky and Kwon, 1994) (in Brosnan, 1998), and measures of computer anxiety have been found to be reliable (Dukes et al, 1989). The prevalence of computer anxiety has also been found to be "a cross-cultural phenomenon (Marcoulides and Wang, 1990; Weil and Rosen, 1995) which, despite the proliferation of computers, has remained endemic" (Durnell and Lightbody, 1994; Brosnan, 1998).

1.2. Early research on computer attitudes, stress and anxiety

There are a considerable number of surveys and other research in the literature on computer attitude, and anxiety as identifiable constructs. However, pioneer studies before 1986 (eg mainly Weinberg, 1980, 1981, 1983, 1985; Howard, 1984, 1986; and Raub, 1981; but also Titus, 1983; Healion, 1983; Sandberg, 1982; James, 1982; Lichtman, 1979; Ahl, 1976; etc) provide a framework for almost all the subsequent research. Most of the fundamental issues are raised in this earlier literature.

Therefore, in considering research on computer attitude and anxiety, it was decided for the introduction of this thesis, that, in general, fundamental studies before 1986 will be reported at the beginning of the general introduction, and studies after 1986 will be presented later in the general introduction. Some additional work will also be reviewed in the introduction to the relevant experimental chapter (chapter 2).

In considering computer stress literature, some original conceptualisation and examination will be reported within the general introduction, while studies of particular relevance to the present research will be discussed in the introduction to chapter 3.

Finally, research on personality variables (in association with computer attitude, anxiety, and stress) will be mainly discussed within the introduction to chapter 4.

1.2.1. The influence on research on computer attitudes and anxiety: Maths attitudes and anxiety, their correlates and treatment

In the previous century, Karl Marx suggested that "every individual, every society, as well as every concept mainly consists of its history". Some of the initial research on computer attitudes and computer anxiety and stress took as its starting point the related issues of mathematics attitudes, anxiety, and stress. Some research on the correlates of maths attitudes and on the treatment of maths negative attitudes and anxiety may be worth mentioning to the extent that it may provide clues in identifying and examining correlates and treatment of computer attitudes and anxiety.

Themes (1982) reviewed some of the maths attitudes and anxiety literature, and pointed out a number of correlates of maths attitudes and anxiety that various researchers had discovered. In particular, test anxiety had been found to correlate strongly with maths anxiety; it was actually shown that maths anxiety appeared to be induced more by the testing than by the mathematics itself. Trait anxiety was reported as another correlate of maths anxiety; the rationale here was that an individual with a high level of trait anxiety would be more vulnerable to all kinds of anxiety, such as maths anxiety, phobias, even computer anxiety, etc. In addition, correlates of attitudes towards mathematics were reported to be maths anxiety, years of mathematics experience, mathematics achievement, performance, sex, and age (Themes, 1982).

Although correlations should be interpreted as indices of association between variables, and not as cause-and-effect relationships, by treating these correlates, maths attitudes might improve and maths anxiety may be reduced. In this context, to the extent that some of these correlates of maths attitudes and anxiety can be shown to be also correlates of computer attitudes and anxiety, treatment for negative computer attitudes and means for alleviation of computer anxiety may be suggested.

In his 1982 study, Themes reported three methods of improving (negative) attitudes towards maths and treating maths anxiety. The first was Ellis and Abraham's (1978) rational-emotive therapy, and entailed an attempt to challenge an individual's irrational beliefs about mathematics. The second method was Meichenbaum's (1977) cognitive behaviour modification, and involved the suggestion that an individual recognises negative self-statements, and replaces them with more realistic positive ones.

The third method was the mathematics skills intervention, and sought to reduce maths anxiety and improve maths attitudes by simply providing experience and knowledge in mathematics. In considering this method, Bander, Russell, and Zamostny (1982) found that this maths skills program achieved the greatest reduction in self-reported maths anxiety and the greatest improvement in maths attitudes, in the short term, compared to cognitive treatments.

In addition, Themes (1982) conducted a quasi-experimental comparison of these treatments, and found that all three significantly improved maths attitudes and reduced maths anxiety. However, Themes found no significant difference among the effectiveness of each of the treatments.

Measures of maths attitudes and anxiety have contributed to the design and development of computer attitudes and anxiety instruments. For example, Raub (1981), in his study of computer anxiety, attitudes and their correlates, used Fennema and Sherman's (1976) Mathematics Attitude Scale (MAS) as a guide, in order to develop a measure for assessing

computer anxiety. Similarly, the Computer Anxiety Rating Scale (CARS, Rosen and Sears, 1984; Marcoulides, 1985) was designed along the lines of the Mathematics Anxiety Rating Scale (MARS, Richardson and Suinn, 1972).

1.2.2. Initial research on computer attitudes, anxiety and stress

Approximately, up to the year 1984, research in computer attitudes and computer anxiety, including both formal studies and reports, had been quite rare. Apart from a few semi-academic studies, most of the initial knowledge on the topic can be derived mainly from the popular business press, where data were derived mainly from personal experiences and interviews.

Some of the early 'more formal' work in the area was done by Weinberg in the United States Saint Joseph's University. In addition to his academic work, Weinberg published several articles on the topic of computer attitudes and anxiety in several publications, such as Wall Street Journal, Computerworld, Interface Age, etc. Weinberg also had been consulting with industry not only on computer anxiety and attitudes but also on other aspects of the human - computer interface.

Weinberg (1983) reported that the computer attitudes and anxiety research field started in 1978. His interest on these issues grew when he was conducting research on methods for teaching computer programming. Weinberg then found that a significant number of individuals appeared to be afraid of computers beyond the usual level of anxiety that often accompanies any new experience; thus, he called this fear or anxiety "cyberphobia".

Furthermore, Titus (1983) described a condition which had been observed in MBA students of Pennsylvania University, USA. He named this condition as "terminal shock", and speculated that it arose when students, under pressure to learn using computers, suffer the frustration of being unable to control the machine. Healion (1983), reporting on the same issue, used the term "compuphobia", whereas Sandberg (New York Times, 1982) named the condition "Computer Fear Syndrome". However, regardless of the term used, it is clear that the issue described had been always the same: computer anxiety.

James (1982) reported Weinberg's estimate that approximately 30% of USA's white collar workers had some degree of computer anxiety with the accompanying negative attitudes towards the machine. Similarly, Weinberg (1983) studied 523 college students and corporate managers over a four-year period by using interview techniques and GSR (galvanic skin response) equipment; he found that nearly the one-third of them suffered from computer anxiety and had a negative attitude towards computers; moreover, he found severe

anxiety symptoms in approximately 5% of his subjects, including nausea, vertigo, and cold sweats.

Paul (1982) reported Weinberg's remark that a great proportion of the individuals found to have computer anxiety and negative computer attitudes were those who had nontechnical jobs or careers, such as clerical work, advertising, or sales, and then they found themselves involved unwillingly or 'trapped' in a computerised environment. Weinberg also stated that one of the major causes of 'cyberphobia' could be considered the feeling that an individual has lost control. This statement provided an initial justification for the inclusion of control and locus of control as possible correlates of computer attitudes and anxiety, as will be introduced in Chapter 4.

Furthermore, speculations had been initiated in the relevant literature that computer anxiety, stress, and negative attitude towards computers can be seen as a temporary problem that will gradually disappear as the new generation of youth, who are exposed to computers at an early age, gradually move into the working population. For example, Sandberg (1982) implied this view by stating that there is nothing intimidating about a computer for children.

On the other hand, Weinberg (1980, 1983) believed that computer anxiety and the accompanying negative attitudes are not temporary problems, partly because many students in a considerable number of high schools and colleges were not provided with an adequate amount of computer experience and knowledge; this was actually reflected in the fact that young people were similar to older ones in the extent to which they had developed anxiety and negative attitudes towards computers (Weinberg et al, 1981, 1983).

In accordance with Weinberg (1983), even people with high computer experience may have computer anxiety and negative computer attitudes because of, for example, "bad experiences with premature releases of faulty software packages".

More initial research on computer anxiety and (negative) computer attitude was conducted by Ledecky (1983). His work suggested that computer anxiety could take three main forms: the general fear of working with computers, the fear of failure in using them, and the fear of being replaced by a computer machine. However, some people have more computer anxiety and more negative attitudes towards computers than others, and this raises the question of what characteristics of an individual are related to his or her proneness to computer anxiety and negative computer attitudes.

Other initial research on computer attitudes and anxiety included work on their correlates by Weinberg and English (1983), on treatment of computer anxiety by Weinberg, English, and Mond (1981), and by Shapiro (1980), on correlates of computer attitudes and anxiety in

college students by Raub (1981), and on computer anxiety, attitudes, and their correlates in managers by Howard (1984, 1986). Raub's research has been particularly valuable because, for the first time, some of the fundamental origins and basic correlates of computer anxiety and attitudes were investigated in a systematic and integrated manner.

1.2.3. Roots and origins of computer attitudes, anxiety and stress

Raub (1981) reported Ahl's (1976) and Lichtman's (1979) semiformal studies of computer attitudes, that sampled and surveyed the general public and educators respectively. Cluster analysis of the responses to Ahl's questionnaire revealed four groups of responses: impact of computers on quality of life, threat of computers to society, the role of computers, and the computers themselves. Similarly, Lichtman (1979) used a slightly modified version of the same questionnaire to sample and survey educators. Although no statistical analysis was performed, inspection of their plotted data suggested that the teacher sample had more negative attitudes towards computers than the general public had. An explanation for that may be that many teachers view computer-aided instruction as a threat to their profession (Howard, 1986).

In a more formal and wide study, reported also by Raub (1981), Lee (1970) studied public attitudes towards computers in a sample of three thousand subjects aged eighteen years old or older. Factor analysis of his questionnaire revealed two independent factors: a) Factor 1: the beneficial tool of man perspective; this represented the majority view and entailed a positive set of beliefs that computers are beneficial in science, industry, and business; and b) Factor 2: the awesome thinking machine perspective; this comprised the science-fiction view of the computer as an autonomous entity, superior to human thought. Lee focused on Factor 2, because the attitude involved there can have a (potentially) serious negative impact on society in general and on the computer industry in particular (Lee, 1970; Raub, 1981).

Additionally, Lee (1970) collected data and information on his subjects' psychosocial attitudes: alienation and intolerance of ambiguity actually accounted for 23% of the variance in Factor 2, and the subjects' education was found to be the strongest "social class indicator" of this factor. Hence, since education may have appeared to increase an individual's ability to tolerate ambiguity and uncertainty, it would be reasonable to speculate that university students, given their relatively high level of education, would probably have less negative attitudes towards computers than the society as a whole.

Lee's 'awesome thinking machine perspective' indicated and implied fear; this fear referred to the computer as an incomprehensible and complex machine with capabilities exceeding those of human thought. This factor reflects ignorance and naivety about the functional capabilities and limitations of computers, and can be seen as one of the earliest discovered

generic origins of computer anxiety and the accompanying negative attitude towards computers. Some students may simply fear the 'awesome' power of the machine, although this fear may be less towards a contemporary desktop, laptop, or notebook computer than a room full of mainframe computer equipment.

Baker (1978) conducted a pilot survey of 74 high school students' attitudes towards computers. His sample included six classes in which the computer was used as an instructional aid. A factor analysis of his 24-item questionnaire yielded seven significant factors. One of these factors, summarised as "Anxiety", was a "bipolar factor describing an emotional dichotomy". In particular, the students reacted to the computer either with uneasiness due to anticipated negative results or with a desire to learn more about computers.

In her study of attitudes and anxiety towards computers in college students, Raub (1981) included a factor analysis that revealed three issues: a) appreciation of computers and a desire to learn more about them, b) anxiety referred to usage of computers, and c) fears about the negative impacts of computers on society. Issues (b) and (c) may provide additional earliest discovered generic origins of computer anxiety and negative computer attitudes.

In particular, some students may have a fear of computer operation in case of an operational failure, such as difficulties in typing or fear of damaging the machine, its contents or destroying their own work by pushing a wrong button. Others may be afraid that computers will have a very negative impact on society because, for example, they isolate people from one another and they threaten people's self-esteem.

Alienation (Raub, 1981) may also be considered as another earliest discovered source (and effect) of computer anxiety and the accompanying negative attitudes towards computers. In particular, alienation from technology can be regarded as a sense or situation of an individual being disconnected from the evolution of technology and the "technological mainstream" (Howard, 1986).

Raub (1981) found that college students with high computer anxiety and negative attitudes towards computers had an experience background of little or no encouragement or necessity to learn about computers or anything else even remotely technical. Thus, it could be argued that when the requirement for computer literacy becomes a necessity for such people, they experience a lot of difficulties and anxiety, and develop even more negative attitudes towards computers. Hence, it is reasonable to assume that many university students, especially the ones who study certain nontechnical subjects or they are computer novices, may experience similar difficulties and anxieties when confronted or anticipate confrontation with computers.

Finally, fear of the unknown can also be seen as an earliest discovered origin of computer anxiety and negative computer attitude. Although fear of the unknown as a root of computer attitude and anxiety has never been psychometrically measured precisely, Raub (1981), in several clinical interviews with negative attitude and high computer anxiety students, found that these people were reluctant to participate in any activity where they had little knowledge of the possible outcome, including such usual activities as meeting new people. This fear of the “untried and unknown” has been associated with fear of failure (Howard, 1984). Themes (1982) identified fear of failure as a correlate of maths attitudes and anxiety. In considering the relationship between maths and computer attitudes and anxiety (eg Raub, 1981; Howard, 1984, 1986; Themes, 1982), it is reasonable to expect that fear of failure may be also strongly present, (and inducing computer anxiety and negative computer attitudes) in computer using university students, and especially to the novices.

In summary, the incidence of computer anxiety and negative attitude towards computers has been claimed to stem from fear of computers as “awesome, superhuman thinking machines”, from their perceived negative impact on society, from fear of failure in their use due to lack of knowledge and experience, and from technological alienation as defined by Raub (1981). These hypothesised factors appear to have provided the original basis for later research on computer attitudes, anxiety, and their correlates.

Following on from this, it is not unreasonable to hypothesise and that computer anxiety and negative computer attitudes account, at least partially, for the resistance to use computers. Interviews with managers reported in the business literature, with students reported by Raub (1981), as well as Howard’s studies (1984, 1986) on managerial computer anxiety and attitude suggested that this resistance has three roots: ‘psychological’ (or personality), educational, and operational.

- a) ‘Psychological’ roots of computer anxiety and computer attitudes derive from computer users’ personality characteristics. Some people are more prone to anxiety and negativity than others regardless of the source of the anxiety and the negative attitude.
- b) Educational or knowledge roots of computer anxiety and negative computer attitudes entail the assumption that, in addition to ‘psychologically’ based fears, lack of knowledge about computers and the limits of their potential or actual use can also induce fear (eg Howard, 1986). In particular, one of the fears about computers that people perceive commonly is that, sometime in the near or remote future, they may be replaced by a machine. Terms, sometimes misleading, such as “artificial intelligence”, appear frequently in the popular, business, and scientific press giving an impression of the computer as a rival not only of a clerk but also a professional, a company manager, or a scientist.

However, this fear is not entirely without a factual basis. Even as early as 1982, Shaffer (1982) reported that a computer program called "Dental" can be more efficient than a chemist at determining molecular structure from spectroscopic data. In addition, medical diagnosis systems (such as The Internist) can diagnose an illness on the basis of symptoms with competence that rivals an experienced medical doctor (Howard, 1986), while other 'artificially intelligent' systems have been successfully used for a wide range of applications from air traffic control to legal issues research.

Another fear, related to the possible and potential intimidation by the computer jargon, is that many people feel that they are already so far behind in learning about or using computers that it is too late and hopeless to try to catch up; and with this predisposition they are sometimes defeated before they start, arguing that they will always be behind, no matter how much they try and learn about computers (Howard, 1986).

Furthermore, another 'lack of knowledge' factor that may contribute to computer attitudes and computer anxiety is the fear of pushing a wrong button and damaging either the computer machine itself or its 'memory' contents (eg Bralove, 1983). This kind of fears can usually accompany an individual's first attempts to operate any new machine (a new vehicle for example), but with computers the fear of causing harm to the machine or its contents may be especially intense because of the complexity, sophistication, and incomprehensibility of the computer machine.

- c) Operational origins of computer anxiety and negative computer attitudes stem from fear of anticipating or facing difficulties in overcoming practical (operational) computer problems and managing appropriate and effective computer use (eg having a problem with typing).

Bralove (1983) told of an installation of a financial-planning computer system in a company where a number of the executives could not or would not type. "The greatest barrier to overcome was the newness of simply sitting down at a terminal" he reported; and also, "Executives wondered if it was an efficient use of their time to be searching for a letter on a keyboard". However, away from the presence of peers or supervisors, people, and students, may be less afraid to experiment with the use of a computer, since mistakes and errors can be private failures rather than public embarrassments (Bralove, 1983).

So, some individuals may avoid personal use of computers because they anticipate embarrassment related to their difficulties or inability to operate the machine. In many cases the problem can be as simple as finding the on/off switch of the computer device the first few times. On the other hand, potential or actual computer users may be able to avoid confrontation

and use of keyboards with the development of computers that recognise or 'understand' voice commands.

The preceding summary of reports and surveys during already the early and middle 80's suggested 1) that many potential or actual computer users (eg students and white collar employees) may personally resist computer-based devices as study or work tools, and 2) strongly suggested that a large proportion of this resistance can be because of fears related to the computers. These fears could be broadly classified as 'psychological' (or personality based), educational, and operational, and can be regarded and defined as computer anxiety and negative computer attitude.

1.2.4 Computer attitudes, anxiety, and their correlates

In order to understand some of the relationships and causes of negative computer attitudes and computer anxiety, Weinberg (1980, 1983), Weinberg et al (1981, 1983), Raub (1981), and Howard (1984, 1986) studied not only the concepts of computer attitudes and anxiety but also their correlates; the results of these studies have been similar.

In particular, Weinberg, (1983), and Weinberg et al (1983) surveyed college students and managers, investigating the relations of computer attitudes and anxiety to a number of other variables, such as prior computer training (i.e. computer experience and knowledge), trait anxiety, maths anxiety, sex, and age.

In Weinberg's studies, it was found that computer anxiety and attitude was significantly correlated with prior computer training (i.e. computer experience and knowledge), and maths anxiety and attitude.

Raub's study (1981) was similarly structured, but additional independent variables were hypothesised as potential correlates. Besides computer experience, maths anxiety and attitudes, trait anxiety, age, and sex, - parents' education and college major of each subject were also used. Trait anxiety was found to be a significant correlate of computer anxiety and attitudes for male subjects, maths anxiety for female subjects, and experience level was found to be a significant correlate for both male and female subjects.

Howard's studies (1984, 1986) were also similarly structured but the subjects were industrial managers. And, in addition to maths anxiety, trait anxiety, computer experience, computer knowledge, sex, and age, - beliefs about impact of computers in society and personality variables such as locus of control and cognitive style were also used as independent variables and suspected correlates of computer anxiety and computer attitudes. Computer experience and computer knowledge were both found to be highly significant correlates of computer anxiety but not of computer attitude.

Beliefs about the impact of computers in society were a highly significant correlate of both computer attitude and computer anxiety, whereas maths anxiety was found to be a highly significant correlate of computer anxiety, but not of computer attitude. Trait anxiety was found to be a marginally significant correlate only of attitudes towards computers. Finally, locus of control was a weak but still a significant correlate of attitudes towards computers (but not of computer anxiety); managers with external locus of control were found to have less favourable attitude towards computers. No significant correlation was found for cognitive style, as measured along Barkin's (1974) scale from analytic to heuristic.

In general, the previously summarised studies suggested that people with less or no knowledge or experience of computers, and people with maths anxiety are most likely to suffer computer anxiety, whereas people with external locus of control, and people with high trait anxiety are more likely to develop negative attitude towards computers. Weinberg (1983) was the first to suggest that a systematic study of 'personality types' as possible correlates of computer attitudes and computer anxiety would be extremely helpful to the understanding of these attitudes and anxiety. However, Howard's studies (1984, 1986) were the first to empirically address the question of whether there are certain identifiable personality variables that made some people more likely to experience computer anxiety and develop negative attitude towards computers.

1.3.Computer attitude, computer anxiety, computer stress, and computer experience

1.3.1. Computer attitude

Approximately 2,500 years ago, Aristotle, the Father of Psychology, suggested that "the main principle and start of wisdom consists of the definition of terms". So, before the present studies are introduced, definitions, brief descriptions, and occasionally other information, about the main terms used in this thesis, will be given. Therefore, definitions of "computer attitude(s)", "computer anxiety", and "computer stress" are prerequisites.

So, in brief, 'attitudes' are a relatively stable set of beliefs, feelings, and predispositions to behaviour and action, that an individual holds towards some idea, object, or person. This meaning of attitude can be basically viewed as an extension of the idea of intention, but contemporary use of the term may generally entail four components, namely: a cognitive one, defined as a consciously held belief, opinion; and rationalisation, which "explain" the holding of the attitude; an affective component, regarded as the emotional aspect of the attitude or feeling; an evaluative component, which may be positive or negative; and a conative or behavioural one considered as disposition for action, i.e. the extent to which the

individuals are prepared to act on the attitude that they hold (Reber, 1985; Straton and Hayes, 1988).

However, there has been considerable dispute as to which of these components should be regarded as more (or less) important: Cognitive theorists usually maintain that "the underlying belief" should be regarded as the fundamental component; on the other hand, behaviourally oriented theorists focus on the "conative" component as the most important, whereas most other researchers feel that a combination of the "affective and evaluative" components are the critical ones.

The significance of attitudes derives from the proposition of attitude theorists (eg Fishbein and Ajzen, 1975, 1980) that an individual's attitude towards an object plays an important role in influencing their subsequent actual behaviour. In particular, Fishbein and Ajzen (1975) described attitudes as a learned predisposition to respond in a consistently favourable or unfavourable manner with respect to an object.

In Miller's Technical Report (1971) it was suggested that the number of people who want to use computers reflects the attitude of actual and potential users, i.e. their like or dislike for the device. There are, of course, many reasons for a like or dislike, not all necessarily connected with the device or service it provides. Nevertheless, the practical issue is that, however it comes about, attitude towards or against a device may be more powerful than any other factor in its rate or scope of acceptance in a general population (Miller, 1983).

Attitudes towards computers reflect the affective or evaluative reactions of individuals towards the use of computers on a favourable - unfavourable continuum (Parasuraman and Igbaria, 1990). However, the cognitive component has long been recognised as a major influence of attitudes (Ostrom, 1969; Rosenberg, 1956; Rosenberg and Hovland, 1960).

As discussed earlier, in one of the first studies on attitudes towards the computer, Lee (1970) showed that the major cognitive dimension which people associate with computers is its benefit to man. Subjects in these early studies on computer attitudes formed their impressions from science fiction books or other 'exotic' sources, whereas modern impressions are more likely based on some type of direct contact (Koslowsky et al, 1990).

Using 412 students as subjects, Morrison (1983) showed that four factors characterised attitudes towards computers: negativism, awesomeness 1, awesomeness 2, and application. The first awesomeness factor related more to the machine, and the second to comprehending its "brain" or inner workings. Subsequent work on computer anxiety (and the accompanying attitudes) by Glass and Knight (1988) showed that a cognitive model would help explain some of the thoughts and feelings expressed by students towards the computer. Peace and Easterby (1973), in their study of computer perception, identified two relevant bipolar

dimensions in subjects' attitudes towards computers: man vs machine, and practical vs theoretical. In each of these attitude studies, a large number of subjects perceived computers as human-like with certain "defined" powers.

Brock and Sulsky (1994) followed up Lee's (1970) suggestion that attitudes towards computers are generally thought to be composed of two factors: (1) beliefs that the computer is a beneficial tool, and (2) beliefs that computers are autonomous entities. The authors employed confirmatory factor analysis and structural equation modelling to examine: (1) the convergent and discriminant validity of scales assessing the two attitude factors; (2) the relative predictive validity of the two attitude dimensions with computer use, and (3) a theoretical model of attitudes towards computers and computer use. Results supported the hypothesis that attitudes towards computers are composed of the two distinct constructs/beliefs originated by Lee (1970). The authors also found that these two beliefs are significantly related as predictors of computer use, although they have a different impact with regard to this prediction.

Jawahar and Elango (1998) made the distinction between general attitudes towards computers versus attitudes towards working with computers. However, their results indicated (weak) support for the (mentioned before) behavioural intentions model of Ajzen and Fishbein (1980), as attitudes towards working with computers were found to be only a marginally better predictor of learning to use computers than the more general attitudes towards computers.

Fisher (1995) found that computer-related attitude was significantly linked to individuals' intentions about use of computers but not to actual computer use. This study examined linkages among individual characteristics, attitudes, computer use, and intentions. Fifty senior managers and executives were interviewed and completed a demographic survey. Accountants were found to have the most positive attitudes towards use of computers than any other subjects' subgroup.

Moreover, using 296 undergraduate students, Zhang and Espinoza (1997) showed that attitude towards computers was a significant predictor for learning computing skills, especially in students from computer classes.

In particular, their study investigated relationships concerning attitudes towards computers, and need for learning computer skills. Students from a regional US state university participated in this study in 1996. The measures used were Attitudes towards Computer Technologies, and Confidence and Desired Knowledge with Computer Technologies questionnaires. Statistical analyses, consisted of simultaneous multiple regression, revealed that attitudes towards computers were significant predictors of the need for learning computing skills for all students.

Furthermore, Levine et al (1997) found that computer-related attitudes had a positive effect on commitment to learning. On the other hand, contrary to these findings, Levine et al (1997) found that computer-related confidence had a negative effect on commitment to learning.

In particular, based on attitude-behaviour theory (which suggests that beliefs about an object lead to an attitude towards it, and that attitudes are an important precursor of behaviour), this study proposed a causal model relating computer-related attitudes (defined as dispositions concerning the computer as an important, interesting, educational, and stereotypical tool), computer-related confidence (degree of confidence when using a computer), and (their effects on) commitment to computer learning (defined as the difference between self-perceived current level of computer-application knowledge and perceived level of desired knowledge).

The model hypothesises that computer attitudes and computer confidence reciprocally affect one other in a positive way, and that both positively affect commitment to computer learning. Questionnaires were administered to 309 seventh to twelfth grade students. The theoretical model was tested by structural equation analysis (using the program LISREL). All causal effects (including reciprocity) were confirmed, except that confidence was found to have a negative effect on commitment to learning, when attitudes were held constant.

In summary, attitudes towards computers have been thought to be composed of beliefs that the computer is either a beneficial tool or an autonomous entity (e.g. Lee, 1970; and Brock and Sulsky, 1994). Most studies (e.g. Jawahar and Elango, 1998; Zhang and Espinoza, 1997; and Levine et al, 1997) suggest that computer attitude is a significant predictor of commitment to learning as well as actual learning to use computers and computing skills. However, Levine et al (1997) reported that computer confidence, when attitudes are held constant, may have a negative impact on commitment to learning to use computers.

1.3.2. Computer anxiety

As with attitudes, how the term 'anxiety' has been used, in psychological literature, has largely depended on the theoretical bias of the researcher. Thus, there are several (complementary) definitions for anxiety; Levitt (1967) has summarised a few, e.g.: "a painful uneasiness of mind over an impending or anticipated problem"; "a danger signal felt and perceived by the conscious portion of the personality; it is produced by a threat from within the personality, with or without stimulation from external situations"; and "an unpleasant emotional state in which a present and continuing strong desire or drive seems likely to miss its goal"; etc.

May (1977) defined anxiety as "an apprehension cued off by a threat to some value that the individual holds essential to his existence as a personality"; whereas Caplan and Jones (1975) noted that "the anxious person sees the danger as a threat either in the near or in the more

distant future". In addition, Freud (1926/1959), Brenner (1953), and Lazarus and Averill (1972) have explained the anticipatory character of anxiety from various points of view. In particular, Lazarus and Averill (1972) pointed out that anxiety accompanies states of uncertainty and/or ambiguity about the future, whereas Lagina (1971) stated that anxiety is "a state of heightened tension or a feeling of apprehensive expectation".

In psychoanalytic theory, 'anxiety' has been treated as in its general meaning, with the additional assumption, that it acts as a signal that psychological danger would result if and when an unconscious wish is to be realised (to become conscious) and/or acted upon (Freud, 1926/1959; Brenner, 1953).

However, despite the semantic details, the delicate conceptual balances, and the fine borderlines among different conceptualisations and interpretations, a clear thread running through most definitions of anxiety may be detected, and that is that the 'anxiety' concept refers to fear about some actual and/or potential threat or danger in the future. This fear can vary in terms of rationality and permanence, i.e. it can be from rational to irrational, and from relatively permanent to temporary (transitory). According to such distinctions, the identification and definition of the relevant subtypes of anxiety have been formed and relatively widely accepted by researchers (e.g. May, 1977; Caplan and Jones, 1975; Spielberger, 1972, 1970; Howard, 1986; etc).

In particular, May (1977) suggested that if the apprehension is proportionate to the actual (objective) danger, the anxiety can be characterised as "normal"; but when the apprehension is disproportionate to the actual danger, then the anxiety can be regarded as "neurotic".

In considering the 'permanence' distinctions of anxiety, Spielberger (1966) distinguished between "trait anxiety" and "state anxiety", both concepts that originated from factor analytic studies by Cattell and Scheier (1958). Specifically, trait anxiety was considered as an anxiety personality characteristic (trait) that does not change significantly over time; it was used to refer to an individual's basic tendency to be anxious. State anxiety, on the other hand, was regarded as a temporary (or transitory) type of anxiety that arises in response to a specific situation, may fluctuate over time, and vary in intensity.

In addition, Spielberger's 1972 research contributed even more to the definitions and measurement of state and trait anxiety. In that, specific objects or situations (e.g. exams) may elicit anxiety states; the states exist at a particular moment in time, at a particular level of intensity, and can recur in the presence of the stimulus situation. State anxiety (A-State), therefore, is a unique emotional reaction that fluctuates according to the presence or absence of a particular stimulus.

In contrast, Spielberger (1970) defined trait anxiety (A-Trait) as

“relatively stable individual differences in anxiety proneness, that is to differences between people in the tendency to respond to situations perceived as threatening with elevations in A-State intensity”.

Trait anxiety also reflects individual differences in the frequency and intensity with which anxiety states are experienced. In particular, as opposed to low A-Trait people, high A-Trait individuals will perceive a greater number of situations as threatening to their self-esteem, and will respond with higher levels of A-State.

In considering the distinctions above, a simple and rough four-way anxiety classification system can be obtained. In that, anxiety can be normal or neurotic (according to the way it relates to an objective threat or danger), and relatively permanent or temporary (according to its frequency and duration). In view of these categories of anxiety, the present studies are mainly concerned with the neurotic and transitory (state or temporary rather than trait) type of anxiety, since this is most relevant to computers.

In this context, computer anxiety could be defined as a tendency or proneness of a specific individual to experience some degree of uneasiness towards an impending use or actual use of computers, fear and hostile - aggressive thoughts about computers in general, and resistance to even thinking about computer technology, these reactions being disproportionate to the actual threat presented by computers (Howard, 1986).

Alternatively, and more generally, computer anxiety could be defined as the (complex) negative emotional reactions that are experienced by individuals who interpret computers as personally threatening. This definition describes a type of state anxiety rather than a type of trait anxiety. Thus, it would appear reasonable to say that computer anxiety represents an anxiety state in that the emotional reactions fluctuate according to the presence (real, anticipated, or in thoughts) or absence of a computer. This hypothesis suggests that an individual's level of computer anxiety may change over time (e.g. Howard, 1984, 1986).

However, it should be noted that since, in general, a greater proportion of high A-Trait individuals experience higher levels of A-State, in both intensity and frequency (Spielberger 1970, 1972), and since computer anxiety can be seen as a 'state' kind of anxiety, then Spielberger's theory may also 'predict' that a greater proportion of high A-Trait anxiety individuals will perceive computers as threatening, and respond with higher levels of A-State to thinking about and/or using computers. Thus, in this context, the extent to which an individual's computer anxiety can change may depend, at least in part, upon his/her level of trait anxiety.

Some of the symptoms of computer anxiety that have been identified include: a perceived loss of control, a fear of negative evaluation, and an unfamiliarity with the language employed by the machines (Cohen and Waugh, 1989). The concept also refers to the tendency of an individual to be uneasy, apprehensive, and phobic towards current or future use of computers in general (Anderson, 1983; Margarita, 1985; and Aarsteinsen, 1986).

Maurer and Simonson (1984) argued that, typically, a computer anxious individual exhibits the following behaviours: an avoidance of computers and the area where they are located, an attempt to shorten the time periods in which computers are used, a display of excessive caution when computers are used, and the making of negative remarks about computers and computing.

As discussed earlier, since the beginning of the 80's, Weinberg (1980), and Weinberg, English, and Mond (1981) had already described computer anxiety (or 'cyberphobia') as a high anxiety response to interaction and/or anticipation of interaction with electronic data processing systems; Schwarzer, Ploeg, and Spielberger (1982) described computer anxiety as "the unpleasant emotional reaction experienced by individuals in threatening situations involving computers", whereas Maurer (1983) regarded computer anxiety as "the fear and apprehension felt by an individual when considering the implications of using computer technology, or when actually using computer technology".

In addition, Raub (1981) defined computer anxiety as "the complex emotional reactions that are evoked in individuals who perceive computers as personally threatening", whereas later Pilotte and Gable (1990) described computer anxiety to be "an unpleasant emotional state marked by worry, apprehension, and attention associated with thinking about, using, or being exposed to a computer".

Marcoulides (1988) studied the possible effects of computer anxiety (and/or computer attitudes) on student achievement in computer skills. The results suggested that computer anxiety was an important predictor of computer achievement. Thus, the author recommended that educational systems that seek to prepare students in the field of computer applications must become particularly concerned with creating less stressful environments.

Furthermore, Bozionelos (1996) investigated the prevalence of computer anxiety by obtaining questionnaire data from a sample of 235 British managers and professionals. Prevalence was defined as the percentage of individuals in the sample with scores above the midpoint on a computer anxiety scale used as a questionnaire measure. The author found a prevalence rate of 21.3%. This rate appears to be high and may have significant negative effects on productivity or ability to adapt to new computer-based technology.

In considering computer anxiety as a universal concept, Marcoulides (1990), in a cross-cultural comparison of computer anxiety, examined and compared the computer anxiety of two samples of college students.

Data were collected from a total of 437 subjects whereas two samples were identified: the first contained 225 American college students enrolled at a large university in Los Angeles, California, and the second contained 212 Chinese college students enrolled at a college located in Hunan, China. Approximately, half the subjects from both samples indicated that they had either taken at least one computer course or taken other courses that required using computers.

The results of the study indicated that the construct of computer anxiety, as measured by the 'Computer Anxiety Scale' (Marcoulides et al, 1985), remained invariant when assessed over the two samples of college students and that computer anxiety was present to a similar degree for both samples of American and Chinese students.

'Computerphobia' can be described as an extreme state of computer anxiety. For many people, the computer represents a barrier to both educational and employment opportunities, and it may be seen as a threatening intruder into their lives. These people are known as 'cyberphobes', 'technophobes', or more commonly, 'computerphobics'. For them, by definition, any actual or imagined interaction with computers may cause disabling levels of anxiety, or trigger an internal dialogue that belittles their ability and undermines their confidence; some are unable to approach computers at all (Jay, 1981). Rosen, Sears, and Weil (1987) reported that not only students but nearly every segment of society is at risk from computerphobia.

It appears then that although computer literacy has become as necessary to students as literacy in reading and writing was to students of previous generations (Ringle, 1981), not all students are comfortable with new demands for computer competence; indeed, many may experience high levels of computer anxiety or "computerphobia". Such students may be fearful or anxious about computers, resistant to talking or thinking about them, or hostile and aggressive towards computers (Rosen et al, 1987). Loyd and Gressard (1984a) suggested that computerphobia may preclude computer competence, and Anderson (1987) found that, regardless of academic discipline, computerphobic students showed much less computer aptitude, literacy, and interest. In addition, Heinssen, Glass, and Knight (1987) reported that due to high levels of computer anxiety, many students may actively avoid using computing facilities.

1.3.3. Relationship between computer attitudes and computer anxiety

In general, throughout the relevant literature, two approaches to computer anxiety can be identified: a) The attitudinal approach which suggests that computer anxiety may be seen as a significant part of general computer attitudes (e.g. Loyd and Gressard, 1984, 1985, and 1987); and b) The approach that considers computer anxiety as independent of computer attitudes construct (e.g. CARS, Marcoulides, 1988; CARS, Heinssen, Glass, and Knight, 1984 – note these are two different instruments).

Despite the fact that several studies have been carried out on computer attitudes and anxiety together, some researchers have suggested that computer anxiety and attitude towards computers should be treated as separate constructs. In particular, these researchers suggested that computer anxiety should be distinguished from negative attitudes towards computers. For example, surveys assessing attitudes (Ahl, 1976; Lee, 1970), have emphasised that computer attitude entails people's feelings about the impact of computers on society, the quality of life, and their understanding of computers. In contrast, computer anxiety involves a more affective response, such that resistance to and avoidance of computer technology are a function of fear and apprehension, intimidation, hostility and worries that one will be embarrassed, look stupid, or even damage the computer equipment.

Kernan and Howard (1990) carried out a study of 328 subjects, 164 males and 164 females, to investigate whether anxiety and attitudes could be meaningfully differentiated. Their results indicated that computer anxiety could be successfully distinguished from computer attitudes in a fairly reliable and valid manner. Some evidence of convergent validity was presented in that computer anxiety was found to significantly correlate with three other anxieties indicates: state anxiety, trait anxiety, and math anxiety. However, computer attitude factors consistently, highly and significantly correlated with these three anxiety variables as well.

On the other hand, as an example, results from a Gressard and Loyd's study (1986), in which 106 college students were administered the CAS (Computer Attitude Scale; Loyd and Gressard, 1984), indicated a close association between computer attitude and anxiety. In particular, low scores on computer anxiety were highly associated with high scores on computer confidence and liking, and high scores on computer anxiety were highly associated with low scores on computer confidence and liking.

A noteworthy observation regarding the various measures of the computer anxiety construct is their tendency to capture more than what might be accurately labelled as computer anxiety. For example, factor analyses of three anxiety instruments [(ATC, CAS (Computer Anxiety Scale), and BELCAT-36)] revealed that the scales were multidimensional in nature, and that they appeared to tap various attitudes towards computers in addition to computer

anxiety. For example, Raub's (1981) analysis of the ATC identified three factors: computer anxiety, impact of computers on society, and computer appreciation. Thus, it appears that computer anxiety along with other categories of attitudes towards computers have frequently been classified together under the general 'umbrella' of 'computer anxiety'.

In the main, it seems that the literature has not distinguished clearly between computer attitudes and computer anxiety. An investigation into the separation of the two concepts may require further investigation. Some researchers' apparent avoidance to expand on this issue may have stemmed from a partial lack of precise definitions of the terms or even some lack of understanding the particular problems involved. However, for the present research, it appears that it would be difficult to use the concept of computer attitude without incorporating computer anxiety into it. It would be interesting though to see what further research on this issue, if any, would conclude.

1.3.4. Relationship between attitude, anxiety, and experience

As early as 1982, Sanberg pointed out that computers are by their nature intimidating to the uninitiated. This remark, that experience / knowledge about computers and computer negative attitudes / anxiety are likely to be inversely correlated, has been suggested nearly throughout all the computer attitudes and anxiety literature. So, overall, knowledge about computers together with computer experience should normally relate to (or maybe produce) a positive attitude towards computers and low levels of computer anxiety.

However, Weinberg and English (1983), by using an interview technique, found no significant correlation between negative computer attitudes/anxiety and computer experience/knowledge. Nevertheless, Raub (1981) found a significant correlation between computer experience and computer anxiety of -0.43 in females and -0.47 in males. He measured the computer experience by using subjective questions that asked subjects (college students) to assess their computer knowledge. However, his technique has been questioned because his measurement of experience lacks sufficient validity and reliability (Howard, 1984).

More recent research, in general, demonstrates that experience with or exposure to computers is positively related to attitudes (e.g. Badagliacco, 1990; Koohang, 1989; Lever et al, 1989). Woodrow (1994), for example, showed that computer experience, or level of computer usage, strongly affects all computer attitudes measures: interest, confidence, perceived utility, and stereotypical attitudes. Other research studies demonstrate that computer experience – both the type as well as the amount – is associated with lower levels of computer anxiety (e.g. Dyck and Smither, 1994). These findings suggest that experience with computers leads to positive

attitudes towards them, and to a reduction in anxiety related to present or future use of computers.

The relevant studies have either measured changes in computer attitude / anxiety levels as a consequence of completing some type of computer course or correlated subjects' reported prior amount of computer experience with their attitude / anxiety scores. In the present chapter, there will be discussion only of studies that correlated subjects' reported prior amount of computer experience with their attitude / anxiety scores. In the introduction to the next chapter (Chapter 2), there will be review of research studies that have, in the main, measured changes in computer attitude / anxiety level as a consequence of completing some type of computer course.

A number of studies have found a positive relation between computer attitude and amount of prior computer experience, and a negative relation between computer anxiety and computer experience (e.g. Levine et al, 1997, 1998; Levin and Gordon, 1989; Koochang and Byrd, 1987; Loyd, Loyd, and Gressard, 1987; Todman and Monaghan, 1994; Maurer, 1994; Rosen and Weil, 1995; Mahmood and Medewitz, 1989; Jay, 1985; Ray and Minch, 1990; Marcoulides, 1988; Heinssen et al, 1987). Selected studies are outlined below.

Computer attitudes and prior computer experience

In considering computer attitudes and experience, Levine et al (1997) found that computer-experience had a positive effect on perceived computer self-confidence, as well as on computer-related attitudes.

In particular, based on attitude-behaviour theory (which suggests that beliefs about an object lead to an attitude towards it, and that attitudes are an important precursor of behaviour), this study proposed a causal model relating measures of computer experience (degree of computer use at home and in school), computer-related attitudes (defined as dispositions concerning the computer as an important, interesting, educational, and stereotypical tool), and computer-related confidence (degree of confidence when using a computer).

The model hypothesises that computer experience positively affects perceived computer self-confidence and computer-related attitudes. Questionnaires were administered to 309 seventh to twelfth grade students. The theoretical model was tested by structural equation analysis (using the LISREL program). Both causal effects were confirmed.

Similarly, in their 1998 study, Levine et al (1998) found again that computer experience (computer use) positively affected perceived computer self-confidence and computer related attitudes, and that attitudes and confidence positively affected perceived computer knowledge.

In particular, based on the concept of computer literacy, and on attitude-behaviour theory (which argues that beliefs lead to attitudes, and that attitudes are an important precursor of

behaviour), this study proposed a causal model linking measures of computer experience (computer use), computer-related attitudes, computer-related confidence, and perceived computer-based knowledge.

The model suggests that computer experience has a positive effect on perceived computer self-confidence and computer-related attitudes. The model also hypothesises that computer attitudes and computer confidence have a positive mutual effect, and that both factors positively affect perceived computer knowledge. As before, questionnaires were administered to 309 students in Grades 7-12. The theoretical model was tested by structural equation analysis (using the LISREL program). All causal effects, including the mutual one, were confirmed.

Also, Levin and Gordon's results (1989) showed that prior computer exposure had a strong effect on attitudes towards computers. Specifically, the purpose of Levin and Gordon's study (1989) was to determine the extent to which prior computer exposure (e.g. has a computer at home; participated in a computer course; knows how to work with computers) affected students' attitudes towards computers prior to computer instruction in school. An attitude questionnaire including cognitive and affective attitude scales was administered to 222 Israeli pupils in grades 8 through 10 who studied in schools where computers had not yet been introduced.

Pupils owning computers and participating in computer courses were more motivated to become familiar with computers, felt a stronger need for computers in their lives, and had more positive affective attitudes towards computers than pupils who did not have computers at home or did not participate in computer courses.

Koohang and Byrd (1987) showed that prior computer experience was a significant factor/predictor of positive attitudes towards the usefulness of a Library Computer System (LCS). In particular, Koohang and Byrd (1987) investigated the impact of the levels of prior computer experience on attitudes towards the usefulness of a Library Computer System (LCS). The subjects of this study were 51 students who were enrolled in a library course in Southern Illinois US University. A portion of this course was designed to train students to use and work with the LCS. The instrument used in this study measured the attitudes of students (who have used and worked with the LCS) to the perceived usefulness of the system. Data were analysed with analyses of variance which produced significant results.

Computer anxiety and prior computer experience

In considering computer anxiety and computer experience, Maurer (1994) has conducted a review of the literature on computer anxiety and its correlates, such as computer experience. He reported that although several articles had been published on computer anxiety and experience, little of what was written was supported by empirical research. Despite this, what research there

was supported the idea that there is a relation between computer anxiety and past computer experience. There is a suggestion that the more the users' experience with computers the lower the levels of their computer anxiety are likely to be.

In 1987 Loyd, Loyd, and Gressard's study, greater amount of computer experience was found to be significantly related to less anxiety and greater confidence and liking of computers. These results were also consistent with Loyd and Gressard's 1984 study. Besides, as a whole, students were found to have a fairly positive attitude towards computers (Loyd, Loyd, and Gressard, 1987).

Specifically, Loyd, Loyd, and Gressard's (1987) study was carried out to investigate the effects of experience on computing attitudes in middle school students, as measured by the Computer Attitude Scale (CAS, Loyd and Gressard, 1984). The authors studied 561 seventh and eight grade students and hypothesised that greater amounts of computer experience would be significantly related to less anxiety and a greater confidence and liking of computers.

Computing experience was recorded as one of four categories (for example, 1 = less than a month, 2 = one to three months, etc), indicating the length of time using a computer. Computer experience was found to be significantly related to all three of the CAS subscales: computer anxiety, computer confidence and computer liking.

In a rare qualitative study, Todman and Monaghan (1994) investigated the qualitative differences in computer experience, computer anxiety, and students' use of computers. Self-report measures relating to computer use were obtained on 180 first year psychology students. The measures were: qualitative aspects of early computer experience (how relaxed and unpressured the experience was and the extent to which the individual had felt 'in control' and competent during the experience); level of computer anxiety, current and anticipated future frequency of use of computers; and age of initial introduction to computers. A path model linking the above variables was proposed and tested.

It was found that all of the predictor variables (qualitative early experience, computer anxiety, and age of initial introduction) exerted direct and/or indirect influences on use made (and expected to be made) of computers, in that positive early experience, low levels of computer anxiety, and early age of initial introduction to computers were associated with more current and anticipated future frequency of computer use. An early introduction to computers was generally associated with a more favourable quality of initial experience, leading to lower anxiety and greater readiness of students to use computers.

Rosen and Weil (1995) examined computer anxiety ("technophobia" as they prefer to name it) in relation to computer experience, as an explanation for low levels of utilisation of computers by teachers in their classrooms, in spite of the wide availability of computer technology in

schools. In this study 171 elementary teachers, and 200 secondary humanities teachers in 54 schools across five urban school districts completed three measures of computer anxiety/computerphobia and a measure of computer/technology experience.

The results indicated that: 1) computers are available at all schools, but are not being used by many teachers; 2) many teachers are computer anxious or "technophobic", particularly elementary teachers and secondary humanities teachers; 3) teachers are most worried about dealing with the actual computer machinery in their classroom, about computer errors, and about learning to use computers; and 4) computer experience is the most prominent aspect of technophobia. Finally, Rosen and Weil (1995) discussed the possibility that teachers' technophobia may have long-term effects on the computer anxiety levels of their current and future students.

However, Mahmood and Medewitz (1989) found that as people become computer literate, they form positive opinions towards Information Technology applications but do not significantly change their attitudes and values towards IT itself. It appears that the central implication of this study is that 'computer phobia', generated by negative attitudes and values towards IT and its applications, is a complex matter that can not be resolved merely by computer literacy.

Jay (1985) investigated computerphobia taking as sample a group of 33 females and 17 males who were enrolled in an introductory psychology class. All 50 subjects were run in one group, were given a copy of the NASC questionnaire, and were asked to indicate on a seven point scale how much they agreed or disagreed with each of the forty items included. Analysis of data suggested once more that, with time and experience, computer attitudes became more positive and less negative, i.e. experience reduced computerphobic attitudes towards computers.

Furthermore, a study undertaken by Ray and Minch (1990) to understand computer users' negative attitudes, anxiety, alienation, and/or frustration, found that computer alienation and anxiety can indeed be used to predict some user's reactions to computers, satisfaction with past computer experience, and attention to information regarding computers. Findings showed that number of years of computer experience was a significant indicator of computer alienation and anxiety, i.e. the more the years of computer experience, the better the attitudes, the less the alienation, anxiety, and frustration, and the higher the satisfaction with computers and attention to information regarding them.

Marcoulides (1988) examined the possible variables that may affect computer achievement. 225 college students were administered the Likert-type 'Computer Anxiety Scale', developed by Marcoulides et al (1985). This is a measure of the subjects' attitude, and perception of their

anxiety in different computing situations. Computer experience was measured by the number of courses taken that involved the use of computers, whilst computer achievement was evaluated by the number of completed homework assignments.

Results clearly showed that those subjects with greater computing experience tended to have less computing anxiety; however some anxiety existed regardless of experience level.

Multiple regression analysis also indicated that computer anxiety is a good predictor of computer achievement in college students taking computer courses. And computer achievement was found to be more a function of computer anxiety ($r = -0.71$), than computer experience ($r = 0.37$).

Marcoulides' studies (e.g. 1987, 1988, 1995) have provided the applicable evidence that the computer anxious student can be taught in a way that will successfully reduce his/her computer anxiety, and consequently, improve computer achievement and utilisation. An essential element for the success of such training programmes, however, is the ability to accurately measure the presence of computer anxiety in students (Marcoulides, 1990).

Heinssen et al's (1987) study examined the behavioural, cognitive, and affective components of computer anxiety, and higher levels of computer anxiety were found to be related to less computer experience. In reviewing some of the relevant literature and justifying the importance of their study, the authors reported that, despite the growing role of computers in society, some individuals may actually avoid and resist learning about computers due to their anxiety. Their sample consisted of 270 introductory psychology students who were asked to complete the CAIN (Computer Anxiety Index, Rohner, 1981, and Maurer, 1983), the CARS (Computer Anxiety Rating Scale, Heinssen, Glass, and Knight, 1984, 1987), and the CEQ (Computer Experience Questionnaire, Heinssen, Glass, and Knight, 1984, 1987). The results showed that correlations were high between CARS and all three (sub)scales of CAS (Loyd and Gressard, 1984 - computer anxiety, computer liking, and computer confidence). Furthermore, the correlation between computer anxiety and CEQ was highly significant, and such that less computer experience was associated with greater computer anxiety.

Within this study, tests were also carried out to assess how computer anxiety on the CARS scale was related to expectations, arousal, state anxiety, thoughts, and performance on an actual computer task. It was found that the higher the individuals' level of computer anxiety, the less well they expected themselves to do on the task and the less confident they were of their ability. During the task, more highly computer anxious subjects also reported greater amounts of state anxiety, more body sensations, and more on-task negative evaluation and overall debilitating thoughts. Furthermore, when task performance was examined, higher levels of computer anxiety were related to longer time spent to complete the task.

In addition, Glass and Knight (1988) used CARS to study 59 undergraduates who were selected from a group of 135 on the basis of their scores on the CARS. In summary, they found that computer anxiety was an outcome of an individual's experience with computers, an individual's internal dialogue, an individual's underlying meaning systems and cognitive structures, and an individual's behavioural acts when working on a computer.

In following up the previously discussed Lee's (1970) computer attitude factors, Hall and Cooper (1991) attempted to give an account of users' interpretation of their experience with computing, according to the success or failure of previous interaction with a computer.

Hall and Cooper (1991) showed that computer users are likely to personalise computers and experience with computers according to the qualities of this experience during computer use. In particular, the authors conducted research in order to examine users' descriptive references to the computer, when reporting success and failure experiences with them. For example, some computer users refer to the computer in psychological terms, while others employ objective instrumental references. Results showed that these descriptive differences were related to experience and were affected by the success or failure of the computer task. Generally, essays which described successful episodes while working on a computer were more often written using impersonal references to the computer; essays describing failure episodes contained more personal and intimate terms for the computer.

Finally, Bloom and Hautaluoma (1991) aimed to examine and assess the effects of self-managed relaxation and cognitive skills training, and the 'friendliness' of computer software on computer anxiety and performance. The subjects were 80 apprehensive computer trainees. Half of the subjects received relaxation and cognitive skills training but the other half did not. Besides, half of the subjects were given computer 'friendly' software and the other half were issued less 'friendly' software.

They found that training in relaxation or cognitive coping skills reduced error rates and task times. On the other hand, coping skills training did not significantly reduce computer anxiety to make a large difference comparing with situations where no coping skills were taught. However, in general, while at least mild computer anxiety was initially present in 89% of the subjects, their anxiety generally subsided enough after training to place more than half of them at or below a generally relaxed or comfortable level.

This could be explained by the little typing which was involved in the course, short task times, the easiness to correct mistakes, natural decrease of emotional and worrying levels, etc; however, with difficult tasks, a greater effect from coping skills training on anxiety might become evident.

Furthermore, computer anxiety was not greatly reduced by employing friendly software. Interestingly, reactions to friendly software showed the teaching of coping skills to be associated with increased anxiety. These latter reactions could be explained due to the coping skills arousing expectations of anxiety towards computers that were not fulfilled by the experience with the friendly software. However, friendly software did have a marked positive effect on error rates and task times. In fact, the results showed that combining relaxation and cognitive coping skills training to reduce anxiety was most effective when the software was less friendly.

1.3.5. Stress and computer stress

No scientific definition has yet been agreed for the concept of stress and early research focused more on evolution and the psychophysiological mechanisms underlying it than on its nature. It is a word which has crept into everyday language and has a wide range of meanings from a mild problem, simply overcome, to overwhelming pressures from which it is difficult or impossible to escape.

Stress is essentially a personal and subjective experience which can be produced in people under conditions where change and conflict are implicated. While for some individuals stress may be a positive experience, for others may be a threat to their well-being and stability. And even the same person can sometimes perceive an identical situation as stressful one day but pleasurable the next. However, there does seem to be an underlying consensus of opinion that stress refers to a high level of arousal which can be harmful both physically and psychologically to the person experiencing it (e.g. Cox, 1978; Cooper et al, 1988).

Cox (1975, 1978) identified three models of stress around which definitions, research and measurement have revolved:

1) The engineering model sees external stresses giving rise to a stress reaction, or strain, in the individual, so the stress is located in the stimulus characteristics of the environment; stress, in this sense, is what happens to a person (not what happens within a person). The concept here is derived from Hooke's Law of Elasticity in physics, which deals with how loads (stress) produce deformation in metals. Up to a point, stress is inevitable and can be tolerated; indeed, moderate levels may even be beneficial and complete absence of stress (as measured by anxiety or physiological arousal) could be detrimental (for example, being so relaxed that somebody fails to notice the car speeding towards him/her when he/she is crossing the road). [This model is reflected in measures such as life events scales or hassles scales (e.g. Hudiburg, 1989)].

2) The physiological model is primarily concerned with what happens within the person, that is, with the “response” aspects, in particular the physiological (and, to a lesser extent, the psychological) changes which occur as a result of stress.

The impetus for this view of stress was Selye’s (1956) definition that “stress is the non-specific response of the body to any demand made upon it.” Selye’s original observations were made when he was a medical student and noticed a general malaise or syndrome associated with “being ill”, regardless of the nature of the illness. The syndrome was characterised by a) a loss of appetite, b) an associated loss of weight and strength, c) loss of ambition, and d) a typical facial expression associated with illness.

Further examination of extreme cases revealed major physiological changes, including enlargement of the adrenal cortex, shrinkage of the thymus, spleen and lymphatics (all involved in the body’s immune system), and eventually, deep bleeding ulcers of the stomach and upper gut. These changes, representing the “non-specific response of the body to any demand made on it”, were supposed to reflect a genuine phenomenon not embraced by specific responses and, as discussed before, Selye called them the General Adaptation Syndrome (GAS).

Critics of Selye’s work say it ignores both the psychological impact of stress upon an individual, and the individual’s ability to recognise stress and act in various ways to change his/her situation (Cooper et al, 1988). It has emphasised however psychophysiological and biological measures (e.g. heart rate).

3) The transactional model. Subsequent and more complete theories of stress emphasised the interaction between a person and his/her environment. Stress in this context is regarded as a “response to internal or external processes which reach levels that strain physical and psychological capacities to, or beyond, their limit” (Cox, 1978).

In the 1970’s, Lazarus suggested that an individual’s stress reaction “depends on how the person interprets or appraises (consciously or unconsciously) the significance of a harmful, threatening or challenging event” (Lazarus, 1975). Lazarus’s work disagrees with those who see stress simply as environmental pressure. Instead, the intensity of the stress experience is determined significantly by how well a person feels he can cope with an identified threat. If a person is unsure of his/her coping abilities, he/she is likely to feel helpless and overwhelmed (Lazarus and Folkman, 1984).

The transactional model represents a kind of blend of the first two models and sees stress as arising from an interaction between people and their environment (Cox, 1978). In particular, when there is an imbalance between the person’s perception of the demand being made on them by the situation and their ability to meet the demand, and when failure to cope is important.

Because it is the person's perception of this mismatch between demand and ability which causes stress, the model allows for important individual differences in what are the sources of stress and how much stress is experienced; people may also differ in terms of characteristic physiological responses to stress. There are also wide differences in how people attempt to cope with stress, psychologically and behaviourally.

A summary of this model and a definition is provided by Cox and Mackay (Cox, 1978) as follows:

"Stress can only be sensibly defined as a perceptual phenomenon arising from a comparison between the demand on the person and his ability to cope. An imbalance in this mechanism, when coping is important, gives rise to the experience of stress, and to stress response. The latter represents attempts at coping with the source at stress. Coping is both psychological (involving cognitive and behavioural strategies) and physiological. If normal coping is ineffective, stress is prolonged and abnormal responses may occur. The occurrence of these, and prolonged exposure to stress per se, may give rise to functional and structural damage. The progress of these events is subject to great individual variation."

Hockey (1984), and Briner and Hockey (1988) defined stress

"in terms of a mismatch or unresolved tension between an existing state and a target state".

The authors suggested that the consequences of stress may be subjective discomfort or unhappiness (assessed by subjective measures), difficulties in job performance (measured by behavioural or performance measures), or biochemical and physiological health indicators (assessed by physiological measures).

While the transactional approach has been very influential, many studies do not adopt the ongoing 'process' aspects that this view suggests. Rather, cross-sectional studies are adopted that look at correlation between sources (stressors) and their effects on psychological and physiological states, affected in some way by 'moderator' variables, such as social support or personality (or even prior experience). This kind of approach can be seen explicitly in Cooper's model of occupational stress (e.g. Cooper et al, 1988).

Interest in the concept of organisational stress has grown significantly during the last two decades, presumably because it is implicated in the aetiology of many diseases, such as cardiovascular disorders, hypertension, and psychosomatic ailments (Cummings and Cooper, 1979; House et al, 1979; Schuler, 1980; Dolan and Tziner, 1988). Much research effort has been invested in attempts to identify organisational and occupational factors that may be related to the probability that an individual will experience stress at the workplace.

On the other hand, technological changes, such as the adoption of computer - based office automation, have been recognised as an actual or potential source which may induce the experience of stress (e.g. Tosi et al, 1986).

In the past decade, and up to now, concern has been raised regarding the stress effects of introducing and coping with computer technology into the office workplace (e.g. Briner and Hockey, 1988; US National Research Council, 1983; Office of Technology Assessment, 1985; Schleifer and Okogbaa, 1990). Computer - mediated work has altered several job and organisational factors related to health (Amick and Celentano, 1991; Smith, 1987), including workload, job control, task content, and interpersonal relations. Computer - related work has also given rise to different than the usual problems and situations, such as the emphasis on cognitive work and the remote access to information (Briner and Hockey, 1988).

However, a review of the job stress literature shows only little evidence of a direct association between computer - mediated work and the experience of stress or stress - related illness or disease (Schleifer and Okogbaa, 1990; Amick and Ostberg, 1987; World Health Organisation, 1987).

In particular, two general questions have emerged from the relevant literature. First, what is it, in the technological change that may generate stress? Dolan and Tziner (1988) suggested that the ambiguity and the uncertainty about performance expectations likely to emerge from the change, carry the intermediate role of exacerbating organisational stress. However, Beehr and Newman (1978) argued that previous exposure to and experience with implementations of automation in the office can mitigate possible adverse present outcomes from office computerisation, such as feelings of losing control over the job.

Secondly, what are the main potential sources of stress in computer users? Briner and Hockey (1988) identified four general groups of principal sources of stress in computer - based work: a) Human factors constraints, including Workstation layout, VDU and keyboard design, Hardware characteristics, and Interface design; b) Work demands, such as Changes in work pattern, Increased cognitive load, Opportunities for control, etc; c) Organisational decisions, including Training and user support, Constraints on communication and social interaction, etc; and d) Personal characteristics, such as Stress tolerance, and Cognitive skills.

Briner and Hockey (1988) concluded that the most promising areas for research in computer - related stress may be those of "working demands" and individual differences. The third and fourth chapters of the present research are actually an attempt to investigate the impact of subjects' personality types and the effects of various specific computer tasks on the stress experienced by the subjects.

1.4. Conclusions and general research questions

Studies reported in this chapter, as well as additional studies reported in the second and third chapters, support the significance of computer experience as a contributor to computer attitude and computer anxiety. However, up to 1984, studies failed to examine the possible relations between personality characteristics and computer attitudes and anxiety. It was only after 1984, when a small number of studies have attempted to do that. A review of these studies will be presented in the fourth chapter, together with a further attempt to examine these relations.

Generally, the present work is concerned with the initial attitudes of users (students) towards computers, the relation of these attitudes to prior experience, and to stress, performance and the personality of the individual. It also looks at the extent to which changes come about as the result of experience gained from some type of computer course. The extent to which individuals find computing stressful was investigated. Studies were conducted employing questionnaire methods to provide data over a three year period.

In general, the present studies attempt to pursue answers to the following questions:

1. What are students' attitudes towards computers? To what degree do students have computer anxiety?
2. To what extent do students have stress, and how do they perform, when actually interacting with a computer?
3. What is the impact of prior computer experience on computer attitude, anxiety, and stress?
4. Can students' attitudes (and anxiety) towards computers be changed significantly by a series of training sessions on computers?
5. Are some kinds of individual more susceptible to negative computer attitude and higher levels of computer anxiety and stress?

In particular, in Chapter Two, computer attitudes (including computer anxiety) and their change are investigated in relation to computer experience. In Chapter Three, computer stress, computer performance, and the impact of computer experience on them are examined, as well as their relation to computer attitudes (including computer anxiety). In Chapter Four, computer attitudes, anxiety, stress, and performance are examined in relation to personality types, such as locus of control, extraversion and neuroticism, as well as A Typology. Finally, the present research concludes with Chapter Five where a General Discussion, Summary and Overview of the topic are presented including conclusions, suggestions, and recommendations.

Note that Appendix Thirteen provides an update of current related research and a summary of recent supplementary information.

CHAPTER TWO

Computer attitudes and the effect of computing experience

2.1 Introduction

As previously discussed (Chapter 1, Section 1.3.4.), it seems more likely from the relevant literature that it would be difficult to use the concept of computer attitude without incorporating computer anxiety into it. Therefore, the present research follows the attitudinal approach which suggests that computer anxiety may be seen as a significant part of general computer attitudes (e.g. Lloyd and Gressard, 1984, 1985, and 1987). Thus, research on computer attitude and research on computer anxiety in relation to experience and training will be reported together.

In general, research demonstrates that experience with or exposure to computers is positively related to attitudes (e.g. Badagliacco, 1990; Koohang, 1989; Lever et al, 1989). Woodrow, (1994), for example, showed that computer experience, or level of computer usage, strongly affects all computer attitudes measures: interest, confidence, perceived utility, and stereotypical attitudes. Other research studies demonstrate that computer experience – both the type as well as the amount – is associated with lower levels of computer anxiety (e.g. Dyck and Smither, 1994). These findings suggest that experience with computers lead to positive attitudes towards them, and to a reduction in anxiety related to present or future use of computers.

The relevant studies have either measured changes in computer attitude / anxiety levels as a consequence of completing some type of computer course or correlated subjects' reported prior amount of computer experience with their attitude / anxiety scores.

In Chapter 1 (Section 1.3.5.), discussion focused on studies that correlated subjects' reported prior amount of computer experience with their attitude / anxiety scores. In this case, a number of studies have found a positive relation between computer attitude and amount of prior computer experience, and a negative relation between computer anxiety and amount of computer experience (e.g. Levine et al, 1997, 1998; Levin and Gordon, 1989; Koohang and Byrd, 1987; Loyd, Loyd, and Gressard, 1987; Todman and Monaghan, 1994; Maurer, 1994; Rosen and Weil, 1995; Mahmood and Medewitz, 1989; Jay, 1985; Ray and Minch, 1990; Marcoulides, 1988; Heinssen et al, 1987).

The present chapter will review research studies that have, in the main, measured changes in computer attitude / anxiety level as a consequence of completing some type of computer course.

Most studies on the impact of computer experience on computer attitude and anxiety through computer training have been attempts to measure the computer attitude and anxiety of the same group of individuals before and after a number of training sessions. Then studies try to assess

the direction and the magnitude of the change of attitude and anxiety scores from before to after computer interaction, i.e. if computer experience through training makes attitude and anxiety to improve or deteriorate and to what extent. Similarly to the studies of prior computer experience, there is evidence that undertaking any of a range of different types of computer training leads to improved computer attitude and decreased computer anxiety. Results have suggested that experience through training may induce more favourable attitudes and reduce or eliminate the fears that users may have (e.g. Reed and Palumbo, 1992; Rosenbluth and Reed, 1992; Galagan, 1983). The impact of training and experience could, therefore, have significant potential effects on the individual's attitudes and anxiety towards technology in general and computers in particular; and because of this, the importance of training and experience within technology and computer contexts should not be easily underestimated.

Appelbaum (1990), for example, suggested training to be an essential necessity within modern organisations, to combat such threats as computer anxiety and negative attitudes. In his words:

“training and education should be conducted under the auspices of the human resources department with input from the Management Information System and data processing departments, and it must get the full support of top management. In general, an organisation should expect to spend about the same amount of money on training each individual that it spends on each personal computer it purchases. Employees will need training for even the most routine tasks, since the manuals and instructions provided with personal computers are not always easy to understand”.

In spite of the substantial number of pre-test/post-test studies reporting a positive relation between computer attitude and computer experience, and a negative relation between computer anxiety and computer experience (e.g. Harrington et al, 1990; Czaja and Sharit, 1998; Brown and Coney, 1994; Gressard and Loyd, 1985; Igbaria and Chakrabarti, 1990), this result is by no means universal. For example, Rosen et al (1987) found that computer anxiety did not decrease with computer experience, and at times actually increased. In contrast, while both McInerney et al (1994) and Leso and Peck (1992) found that computer anxiety generally decreases with experience, they also found that high levels of computer anxiety persist in some individuals despite training. Similarly, Koslowsky et al (1987) found no improvement in students' computer attitude, Woodrow (1994) found neither improvement of attitudes nor reduction of anxiety, and Temple and Gavillet (1990) found no decrease in older novice users' computer anxiety as a function of training. Moreover, Chu and Spires (1991) showed that a computer course may be an appropriate method to reduce computer anxiety, but only for some cognitive styles. Finally, while Lambert (1991) found a relation between computer anxiety and computer experience, those subjects with initially low levels of computer anxiety experienced increased levels of state anxiety when faced with a novel task.

Thus, the relation between computer anxiety and computer experience seems to be more complex than a general reduction in anxiety with experience. On the other hand, with regard to the possible effect that computer experience may have on computer-related attitudes, Kay (1993) emphasises the contextual significance of such experiences and the differential effects they may have on enhancing computer attitudes.

A representative sample of these empirical studies will be reported in some detail below. The criterion of selection was their contextual similarity to the present research. These studies illustrate the main issues arising in the area. Firstly, studies with mainstream conclusions will be reported (e.g. Gressard and Lloyd, 1985; Harrington et al, 1990; Brown and Coney, 1994; and Czaja and Sharit 1998). These studies suggest that computer attitude improves and computer anxiety reduces as a function of experience gained from some type of computer course. Then, studies with different conclusions than the mainstream will be reported (e.g. Woodrow, 1994; Igbaria and Chakrabarti, 1990; Chu and Spires, 1991; Rosen, Sears and Weil, 1987; and McNerney et al, 1994). These studies present complications and exceptions indicating that the relation between computer attitude/anxiety and computer experience can be more complex than a general improvement on attitude and reduction in anxiety with experience.

In a pre-test/post-test study, Gressard and Loyd's (1985) results showed that amount of computer experience was related to computer attitudes, with more computer experience corresponding to more positive computer attitudes. Furthermore, Loyd and Gressard (1985) found that experience with computers was significantly and negatively correlated with computer anxiety.

In particular, Gressard and Loyd (1985) examined changes in teachers' attitudes towards working with computers from the beginning to the end of a staff development course, and found that anxiety decreased and computer attitudes improved as a result of this experience with computers. A similar result was found regarding student attitudes, when in 1984, Loyd and Gressard conducted research involving 155 eight through to twelve grade students. Teachers and students (for the two studies respectively) were administered the CAS (Computer Attitude Scale, Gressard and Loyd, 1984).

Harrington et al (1990) carried out a study, with the purpose of exploring the nature of the relationship between computer anxiety and computer use within a training context, and also to investigate whether the nature of computer based training affects computer anxiety and computer based learning. They expected that computer based training may help to alleviate computer anxiety, with experience. However, they also suggested that computer anxiety had been shown to adversely influence the effectiveness of computer based training.

They put forward the following propositions: a) in general, a user's level of computer anxiety should be reduced by exposure to computer based training; b) in general, computer based training will be less effective for individuals high in computer anxiety than those in low computer anxiety; c) the effects of lecture / demonstration training will be different than the effects of self-paced tutorial training on subsequent levels of computer anxiety and learning; and d) highly computer anxious individuals are expected to learn more and be less anxious as a result of self-paced tutorial training than training via lecture / demonstration (Harrington et al, 1990).

In their study seventy four undergraduate students voluntarily participated in a laboratory experiment involving the learning of WordStar, a personal computer word processing software package. The experiment constituted a 2x2x2 factorial design: two levels of computer anxiety (based on a pre-experimental questionnaire), two types of training (lecture / demonstration versus self-paced tutorial) and a matching / non-matching of personal preference for a particular learning mode. Results indicated that pre-experimental computer anxiety directly affected post-experimental computer anxiety, number of questions asked during training, and future intentions to avoid using WordStar. Type of training affected the number of questions asked and marginally influenced the number of errors. Preferred choice of training demonstrated no main effects but did interact with the other independent variables. In general, the initial hypotheses were confirmed by the results, and the findings overall indicated that computer anxiety can be influenced and reduced by the type of training provided and the receipt of a desired training approach.

In 1994, Brown and Coney attempted to determine physicians' anxiety towards computer use (computer anxiety) and their attitudes towards medical computer applications. The subjects were 51 US interns, their average age was 27 years, 33% were female, 7% were African American, and 8% were foreign graduates. A standardised questionnaire was used. The 51 participants were surveyed twice, before and after three months of differential exposure to three clinical information systems (CISs).

The most common previous exposures to computers were for literature searching and retrieval of patient information (both 92%). Factors that commonly emerged as predictive of anxiety about computer use included computer attitudes and self-rated skills. Factors found to be predictive of attitudes towards computers included maximal frequency of prior computer use, computer anxiety, computer ownership, and self-rated skills.

Czaja and Sharit (1998) examined attitudes towards computers as a function of experience with computers and computer task characteristics. A sample of 384 adults ranging in age from 20 to 75 years performed real world computer tasks for a three-day period. A multidimensional

computer attitude scale was used to assess attitudes towards computers pre-task and post-task. It was found that experience with computers resulted in more positive attitudes for all subjects across most attitude dimensions.

However, not all studies find such a straight forward relation. For example, in a pre-test/post-test study, Woodrow (1994) measured the computer-related attitudes (including computer anxiety) of grade eight and grade eleven students, the correlates of these attitudes, and the gains in these attitudes. The attitudes were measured along the dimensions of anxiety, confidence, liking, interest, and acceptance. Attitude questionnaires were distributed before and after computer training provided by a course in computing.

The results of the study indicated that the computer-related attitudes of secondary students are positive, stable, and resistant to change. Unstructured computer experiences and word processing experience accounted for the greatest variance of all attitude dimensions. However, tests indicated that gains in attitudes were independent of computer training, and computer course achievement. This result shows that general computer training does not improve attitudes or reduce anxiety. It is the users' unstructured computer experiences based on the users' current computing needs (e.g. in word processing) that mainly accounts for the improvement of computer attitudes and reduction of computer anxiety.

Igbaria and Chakrabarti (1990) looked at computer training and experience and its effects on computer anxiety and attitudes towards computers, and found that computer experience contributed strongly to decrease in computer anxiety and had a direct effect on attitudes towards computers. Their survey gathered data from 187 participants who were all part-time MBA students from a Mid western US university, employed full-time in a variety of manufacturing, service, merchandising, financial services and government organisations, and held professional and managerial positions in a wide range of function areas including accountancy, finance, marketing, general management, information systems and engineering.

Results of multiple regression analysis showed that computer training contributed strongly to decrease in computer anxiety but had only an indirect effect on attitudes towards computers (through computer anxiety). However, computer experience was found to affect the attitudes and anxiety towards computers directly.

Chu and Spires (1991) also examined the usefulness of computer courses in reducing computer anxiety. They expected individuals to exhibit less computer anxiety after rather than before taking a computer course. Similarly they expected to see a negative relation between the number of computer courses an individual has taken and computer anxiety. This was supported by the fact that research had already suggested certain facets of computer anxiety to be reduced

by computer instruction (e.g. Andersen et al, 1980-81; Jordan and Stroup, 1982; Powers et al, 1973; and Raub, 1981).

Their findings, however, differed from mainstream conclusions in that they showed that a computer course may be an appropriate method to reduce computer anxiety, but only for some cognitive styles, such as the intuitive - thinking one; individual instruction or special counselling might be preferred for another cognitive style. Also, and in order to significantly reduce certain facets of anxiety, either other methods or differently constructed computer courses may be required (Chu and Spires, 1991).

Furthermore, Rosen, Sears and Weil (1987) carried out five studies of over 450 university students using as measures the CARS (Heinssen et al, 1987), CAS (Computer Attitude Scale, Loyd and Gressard, 1984), and CEDQ. The Computer Experience Demographics Questionnaire (CEDQ) was also included to assess demographic characteristics of the sample, including age, ethnic identification, gender, class level, computer experience, computer ownership, video game experience, and calculator ownership and experience.

Three research and clinically based self-report instruments were developed to measure three nearly independent dimensions of computerphobia: computer anxiety, computer attitudes, and computer cognitions and feelings. In particular, analysis of data did show some overlap between these three forms, but to a great extent, they were independent of one another.

Results indicated that computerphobia was related to other anxiety measures (mathematics, state, and trait); however it could still be regarded as a separate construct. It was not found to be either simply due to a lack of exposure to computers, and therefore was not completely explained by computer literacy and experience. In addition, it appeared that computer phobia could take at least three forms: it may be displayed as anxiety about computers, as negative attitudes about computers, or may engage in disabling internal self-critical dialogues when interacting with computers (Rosen et al, 1987).

A relationship between computerphobia and computer experience was also examined. According to Rosen et al's hypothesis, if mere interaction with computers reduces computer anxiety and improves attitudes, then working with a computer four hours per week, over a ten week course, at least should reduce, if not eliminate, computerphobia. However, not only were no significant changes with experience found in computer anxiety or computer attitudes, but actually a number of students became more anxious and developed more negative attitudes after working with computers.

As some controversy exists over the merits of increasing experience with computers in order to reduce computer anxiety, McInerney, McInerney, and Sinclair (1994) assessed the effects of increased computer experience on computer anxiety for students enrolled in a University

teacher education course. The Computer Anxiety Rating Scale (CARS) was used to measure computer anxiety prior to and at the conclusion of computer training.

It was found that many of the teacher trainees in this study exhibited a high degree of computer anxiety on a number of key dimensions related to computing. Further evidence from this study gives some support to the notion that increased experience leads to a diminution in computer anxiety. However, the high levels of anxiety remaining for some students after treatment suggest that a simplistic belief that increased computer experience alone will reduce computer anxiety is not tenable.

Conclusions and research questions

So, the effects of computer experience on computer attitudes have been studied by a number of researchers. Their findings are varied and sometimes contradictory. There is certainly a need for further research into this area - an investigation which combines the following: 1) correlates prior experience with computer attitude (and computer anxiety) scores, 2) directly studies the effect of a structured series of computer interaction (within some type of computer course) on those scores, and 3) relates prior experience to the effect of a computer course on attitude/anxiety scores. This can be done by assessing prior computer experience, as well as measuring attitude both before and after the subjects have had some computing experience within a computer course; and this is the orientation of this study.

In general, the aims of this study can be considered in terms of the following research questions:

1. 1. What are students' attitudes (including anxiety) towards computers?
2. Do students' attitudes towards computers change significantly as a result of several training sessions on computers?
3. Do those subjects with greater prior computing experience have more positive attitudes than those subjects who have relatively less?
4. Is prior computer experience related to changes of attitudes from before to after a computing course?

2.2 Method

2.2.1 Subjects

The subjects were Undergraduates at the University of Durham taking the required psychology practical sessions which have a computing component. This included introductory and advanced information and practice on the respective University Computer Operating System [MTS (Michigan Terminal System) in academic years 90-91 and 91-92, and UNIX in academic year 92-93]. It also contained basic and further (advanced) information and practice on a Screen Editor (CURLEW) and an electronic mail utility (EMU).

None of the subjects had studied Psychology previously at University, and most were in their first year of study.

The subjects were the first year psychology practical class of Durham University for three subsequent academic years, consisting of:

- i. Academic year 1990-91 - 99 individuals, 44 males and 55 females;
- ii. Academic year 1991-92 - 106 individuals, 47 males and 59 females;
- iii. Academic year 1992-93 - 119 individuals, 52 males, 58 females, and 6 unknown (missing data).

In total, the number of subjects participating in this study was 324 (143 males, 172 females, and 6 unknown).

Psychology undergraduates were easily accessible and thought to cover a fairly broad spectrum at least of the university population as a whole. Also, the use of first years was necessitated by the nature of the investigation, looking at the effects of computer experience to attitudes.

2.2.2 Materials and Measures

2.2.2.1 CAS: COMPUTER ATTITUDE SCALE

Loyd and Gressard's (1984), 'Computer Attitude Scale' was used. This is a Likert-type instrument, consisting of 30 items, which present statements of attitudes towards computers, learning about, and the use of computers (See Appendix 1). The instrument provides for scores on three subscales: Computer Anxiety, Computer Confidence, and Computer Liking.

Computer anxiety was defined as "resistance to thinking about computer technology", fear of computers, and hostile or aggressive thoughts about computers (Loyd and Gressard, 1984;

Winter, 1984). Computer liking was enjoyment in working with computers, and confidence is reliance in the ability to use and to learn about computers.

Each subscale consists of ten items, and contains positively and negatively worded statements. Items on the Computer Anxiety Subscale comprise such statements as "Computers make me feel uncomfortable" (Item 16), and "Computers do not scare me at all" (Item 1). On the Computer Liking Subscale, items contain such statements as "I would like working with computers" (Item 3), and "I don't understand how some people can spend so much time working with computers and seem to enjoy it" (Item 18). Typical statements on the Computer Confidence Subscale include: "I am sure I could do work with computers" (Item 11), and "I'm not the type to do well with computers" (Item 14).

In Loyd and Gressard's original study (1984), all 30 items were selected by a panel of judges from an original pool of 78 items to represent each of the three attitude domains. Overall, out of thirty, fifteen of the items are content reversed. These statements are also listed in random order with no category designation given. In response to all statements, subjects indicate which one of a set of seven ordered responses (ranging from 'strongly disagree' through 'neutral' to 'strongly agree') most closely represents the extent to which they agree or disagree with the ideas/feelings expressed.

The responses for the positively worded items were recorded so that strongly disagree = 1, disagree = 2, mildly disagree = 3, neutral = 4, mildly agree = 5, agree = 6, strongly agree = 7. The responses for the negatively worded items were recorded oppositely, i.e. strongly disagree = 7, disagree = 6, mildly disagree = 5, etc.

Loyd and Gressard in their 1984 study used a six-point scale, whilst in 1985 and 1987 they included only four options. For this study, it was decided that a choice of seven responses would provide a sufficiently sensitive scale to indicate any change in attitude, and would include a middle 'neutral' response.

Item responses are coded so that a higher score corresponds to a higher degree of confidence or liking, and a lower degree of anxiety. By summing the items ratings on the respective subscales, with scores for the negative items reversed, three subscores are obtained for each student, one score for each of the three subscales. Scores on any subscale range from 10 to 70, and in general a higher score corresponds to a more positive attitude towards working with and learning about computers.

The reliability and factorial validity of the CAS, and its three subscales, have been examined in Loyd and Gressard's studies. In their 1984 study the coefficient alpha reliabilities for each subscale were calculated to be 0.86, 0.91, 0.91, and 0.95 for Computer Anxiety, Computer Confidence, Computer Liking, and Total Score, respectively. Very similar reliabilities were

obtained from their subsequent 1986 and 1987 studies. Intercorrelations among the subscales ranged from 0.64 to 0.80. Loyd and Gressard (1984b) noted that the alpha coefficients and results of the factor analysis suggest that the three subscales adequately represent separate scores; however the relatively large intercorrelations among the subscales indicate that combining them into a total score representing a general attitude towards computers is also appropriate. However, for purposes of this study, the separate subscale scores were used in order to highlight more precisely any differences in computer attitudes as related to attitude change and computing experience (see also Technical Appendix 1).

The CAS takes less than fifteen minutes to administer and complete. It is a convenient and effective device for documenting computer attitudes together with changes in computer attitudes as a result of computer interaction.

Furthermore, in considering the relevant evidence in literature, the CAS has been a well established instrument. It has also been a very popular measure and a large number of studies in computer attitudes (including anxiety) and experience have been conducted by using the CAS.

2.2.2.2 DCAS: DURHAM COMPUTER ATTITUDE SCALE

As reported in the Introduction to Chapter 2, Todman and Monaghan (1994) conducted a qualitative study on the differences in computer experience, computer anxiety, and students' use of computers. Self-report measures relating to computer use were obtained on 180 first year psychology students. Among the self-report measures there were: qualitative aspects of early computer experience, i.e. how relaxed and unpressured the experience was and the extent to which the individual had felt 'in control' and competent during the experience. It was found that a more favourable quality of initial experience, led to lower anxiety and more positive attitude towards computers (for example, greater readiness of students to use computers).

The 'DCAS' was used, among other reasons, because it is concise and effective in obtaining an overall computer attitude ('liking') score, it has been tested successfully in Durham psychology students for years (Crook, 1989), and in addition asks for supplementary qualitative information about the subject and his experiences and/or feelings about computers. For this study, selected items from this questionnaire, (and only at the beginning of each of the three academic years of data collection), were used to identify potential correlates of computer attitudes. These are outlined below, whilst more detailed information about the coding and processing of data is contained in the relevant results section.

The DCAS is an unpublished twenty-item Likert scale which measures the degree of liking for using computers. It was devised by Rosemary Stevenson and her colleagues (1986, Department of Psychology, Durham University) to assess the computer attitudes of undergraduates. The

scale consists of 20 items, and contains positively and negatively worded statements such as 'Computing helps me to think clearly and logically', and 'Computer users forget how to communicate with other people', etc. Each statement is presented with five alternative responses indicating the subject's degree of agreement with the statement. Each is assigned a number ranging from 1 - 'strongly agree' through 3 - 'undecided' to 5 - 'strongly disagree'. Some of the values are then reversed so that a high score represents a positive attitude and, in particular, more "computer liking". By summing the items ratings on the scale, with scores for the negative items reversed, one score is obtained for each student. This score may range from 20 to 100.

A reliability coefficient was calculated to be 0.82, and factor analysis indicated a single factor (labelled 'liking') (Charles Crook, 1990; Personal communication) (for actual questionnaire see Appendix 2).

2.2.2.3 Potential Correlates within DCAS

i. Number of Computer Uses

A choice of eight alternative uses of computers was provided in Question 1 of the DCAS. Subjects were required to indicate what sorts of things they use computers for by rank ordering the computer activities listed; i.e. subjects were required to indicate their most common use by ranking the item '1', their next most common use by ranking the item '2', the next by ranking the item '3', etc. Alternative uses include Communications, Word Processing, Games, etc. In this way, within question 1 of the DCAS, subjects also indicate which (and therefore how many) of the eight alternatives they have used.

This information was particularly useful in this study, because it was used as a measure of subjects' prior computer experience. On the basis of replies to Question 1 of DCAS, subjects were classified in four groups according to their level of computer experience gained prior to any experience with computers in the University.

ii. Reported Attitude

Subjects were required to report any particularly positive or negative attitudes towards (using) computers, and outline the quality of their experiences which have produced such feelings (Questions 8 and 9, Part II of DCAS, see Appendix 2).

The responses to the questions 8 and 9 of DCAS in addition to their positive/negative classification have been further categorised into: 1) those experiences, adjectives or opinions which relate to the computer and 2) those that relate more to personal ability or feelings.

2.2.2.4 CODE NAME

An instruction sheet was produced outlining in brief the nature of the investigation and how to devise a code name to be entered on each completed questionnaire. This would provide identification unique to each subject and ensures confidentiality. Also, the code name, as well as Question 4 in DCAS, obtained information on sex for each participant (see Appendix 3).

2.2.3 Procedure

Three 3 hour practical sessions were held each week (on Thursday, Monday, and Tuesday) at the beginning of each of the three academic years of data collection, and students/subjects were required to regularly attend one of them. The computing practicals were held for four weeks in academic year 90-91, for three weeks in academic year 91-92, and for four weeks again in academic year 92-93. Tests 1 and 2 took place at the very beginning and end of each academic year respectively, and the procedure was similar for both.

Subjects were administered the CAS and DCAS at the beginning of their first Practical session, together with an instruction sheet explaining briefly about the survey and how to devise a code name. This sheet reassured students that all information given would be entirely confidential and used only for research purposes. Besides, it was suggesting that a private note of the code name was kept as the same code name was likely to be used again on later occasions. Also, a brief introduction was given orally, explaining that the questionnaires formed part of a PhD research, outlining the nature of the investigation and what they had to do. The subjects were then given time to complete the questionnaires, after which they were collected individually, and briefly checked to ensure that there was no missing data. In this event, the subject was asked to complete the missed item.

At the end of the academic year, subjects were administered the CAS and DCAS at the beginning of their last Practical session. By this time, they had a quite good idea about the survey; however they were also given an instruction sheet reminding them not only the purpose of the study but also how they had devised their code names at the beginning of the academic year. It was obviously essential that this was the same code name that they had used on all previous occasions, so that their responses could be compared to those taken earlier in the academic year. In all cases the researcher remained present during distribution, completion and return of the questionnaires.

Exceptionally, at the end of the academic year 1991-1992 only, it was not possible for the same procedure to be followed due to time shortage. In this case students were given the two

attitude questionnaires and then they were asked to return them completed via internal mail. Although efforts were made to collect all outstanding questionnaires, the return rate was low.

Within the academic year 90-91, the first week's practical was an introduction to the use of computer terminals, some general information about the University - MTS Computer Operating System, and an introduction to the CURLEW Screen Editor as well as exercises to practise with the editor. The second week's practical included an introduction and practice with electronic mail (i.e. EMU - Electronic Mail Utility). The third week's comprised further information on MTS and practice with MTS commands and electronic mail, introduction to Curlew Block Mode and printing. Finally, the last week involved further information on MTS and more practice with MTS commands, advanced Curlew screen editor (including block mode), advanced electronic mail, printing and paging commands and printing facilities.

Similarly, in the academic year 91-92, the first week's practical was again an introduction to MTS and CURLEW. While the second practical included information and practice on EMU, the third one was about advanced MTS (further commands), Curlew 'Block' Mode, and printing.

At the beginning of the academic year 1992-93, the Durham University computer operating system changed from MTS to UNIX. The first week of practicals contained an introduction to UNIX, and to the CURLEW screen editor. The second week involved information on and practice with EMU within UNIX. The third practical contained further information about UNIX, more practice with UNIX commands as well as electronic mail, introduction to Curlew block mode and printing. The fourth week involved information and exercises on UNIX commands, advanced CURLEW screen editor (including block mode), advanced use of EMU, and printing commands and facilities.

Subjects were firstly taught in a Psychology Department lecture room about mainframe computing and computer facilities in the University in general, and in the Psychology department in particular. Afterwards each set of students (approximately the one third of the class) was further divided into two sub-groups. The first sub-group remained in the lecture room while the second moved to the Psychology Department computer room for actual computer operation - practice and application of what they had been taught during the preceding lecture. After finishing computing, the second group returned to the lecture room and then the first group moved to the computer room for their terminal session.

2.3 Results

Firstly, the initial (i.e. Test 1) attitude scores obtained in this study (from both CAS and DCAS) will be reported and the means and standard deviations obtained on each scale and subscale will be described.

Secondly, the differences between the attitude scores obtained from the first test and second test will be assessed and the direction of change analysed. Data will only be shown for subjects who completed both tests, i.e. at the start and at the end of each academic year.

Thirdly, the relationship between the subjects' initial attitude scores and previous experience will be described and analysed.

2.3.1. Initial computer attitudes - The CAS and the DCAS

(1. What are initial students' attitudes towards computers?)

The means and standard deviations of scores for all computer attitude scales (i.e. Computer Anxiety, Computer Confidence, Computer Liking, and DCAS), for Test 1 only, are presented in Table 2.1. On each subscale of the CAS, scores can range from 10 to 70, with higher scores indicating a more positive attitude and where a score of 40 would be neutral. On the anxiety subscale higher scores indicate less anxiety and a more positive attitude. The DCAS score range is from 20 to 100, where a neutral score would be 60.

Table 2.1. Initial computer attitude scores. Means and Standard Deviations of Computer Anxiety, Computer Confidence, Computer Liking, and DCAS initial scores for each academic year of data collection separately

Test 1	Ac. year 90-91		Ac. Year 91-92		Ac. Year 92-93	
	N = 99		N = 106		N = 116	
	Mean	StDev	Mean	StDev	Mean	StDev
Anxiety	48.29	12.86	46.60	12.01	45.34	12.87
Confidence	46.08	11.61	44.80	10.33	44.62	11.97
Liking	43.79	12.13	41.25	10.58	42.36	10.40
DCAS	66.79	11.86	62.51	11.66	63.36	12.86

Table 2.1 suggests that the means are slightly above neutral. The means indicate that students as a whole had neutral (i.e. scores around 40) to slightly positive (scores slightly higher than 40) attitudes towards computers on all scales. The standard deviation ranges from 10.33 to

12.87, the scores are approximately normally distributed, and the distributions for all CAS subscales and DCAS look very closely to normal.

Computer anxiety seems to increase (with scores seeming to decrease) from academic year 1990-91 (first year of data collection) through 91-92 (second year of data collection) to academic year 1992-93 (third year of data collection). This may initially suggest that increasing general implementation and use of computers within this period is not necessarily decreasing computer anxiety. However, One-way ANOVA (Analysis of Variance) on Anxiety showed that the increase of computer anxiety during this period is not significant. One-way ANOVAs on Confidence, Liking, and DCAS showed that the changes of the scores of these variables during this period are not significant either. Thus, the combination of all three years of data collection together for analysis seems to be justified.

2.3.2. Effects of computing experience in the practicals on attitude

(2. Do students' attitudes towards computers change significantly as a result of several training sessions on computers?)

The means and standard deviations of scores for all computer attitude scales (i.e. Computer Anxiety, Computer Confidence, Computer Liking, and DCAS), and for both Tests (i.e. 1 and 2), are presented in Table 2.2.

Table 2.2. Initial and final computer attitude scores. Means and Standard Deviations of Computer Anxiety, Computer Confidence, Computer Liking, and DCAS scores for each academic year separately [Note that these data are based on the same subjects (paired samples) on the two different occasions, i.e. Test 1 and Test 2].

Academic year 1990-1991				
N = 85 (82 for DCAS)				
	Test 1		Test 2	
	Mean	StDev	Mean	StDev
Anxiety	47.68	12.87	46.08	13.35
Confidence	45.60	11.26	42.82	11.63
Liking	43.57	12.28	37.96	11.57
DCAS	66.14	11.90	63.12	12.76

Academic year 1991-1992

N = 29

	Test 1		Test 2	
	Mean	StDev	Mean	StDev
Anxiety	44.72	14.16	44.48	13.01
Confidence	42.41	11.27	41.58	12.50
Liking	40.37	12.31	35.89	12.67
DCAS	62.06	12.59	58.31	13.71

Academic year 1992-1993

N = 55 (51 for DCAS)

	Test 1		Test 2	
	Mean	StDev	Mean	StDev
Anxiety	44.10	12.85	44.90	12.33
Confidence	43.36	11.46	42.49	11.31
Liking	42.60	10.82	37.58	11.37
DCAS	61.03	13.75	60.54	13.93

The means indicated again that students as a whole had neutral (i.e. scores around 40) to slightly positive (scores slightly higher than 40) attitudes towards computers on all scales and for both tests (1 and 2) except for Computer Liking where the mean for Test 2, and for all three years of data collection, was slightly negative (slightly lower than 40).

The original hypothesis was that the subjects' attitude scores on Test 2 would be higher than on Test 1. However, inspection of Table 2.2 indicate that (with one exception) for all scales and for all years of data collection, the mean scores for Test 2 were actually lower than for Test 1, in general suggesting a shift to less favourable attitudes.

In order to increase the size of the sample, it was decided to look at the data after collapsing over all three years. This is shown in Table 2.3.

Table 2.3. Initial and final attitude scores. Means and Standard Deviations of Computer Anxiety, Computer Confidence, Computer Liking, and DCAS scores, over all three years collapsed together, and for all subjects as 'paired samples' on the two different occasions, Test 1 and Test 2

All three academic years collapsed together				
N = 169 (162 for DCAS)				
	Test 1		Test 2	
	Mean	StDev	Mean	StDev
Anxiety	46.01	13.12	45.42	12.91
Confidence	44.32	11.34	42.50*	11.62
Liking	42.71	11.82	37.48**	11.65
DCAS	63.80	12.78	61.45*	13.36

* $p < 0.01$ ** $p < 0.001$

With the larger sample sizes obtained by collapsing the data over the three years of collection, repeated measure t tests indicate that while computer anxiety does not change significantly, confidence decreases significantly, and there is a marked (highly significant) decrease in liking (liking score falls below mean of 40 on Test 2). DCAS scores also decrease significantly.

2.3.3. Effects of computing experience prior to the practicals on attitude and attitude change

Students do not all start these practicals as naive computer users. Most of them have gained at least some computer experience before they start their first year of psychology studies. At this stage, some students are familiar with computer games, others with word processing or communications, and others even with programming or statistical analysis.

A possible hypothesis here may be that those subjects with greater initial computer experience would have more positive attitude (including less anxiety) towards computers than those subjects who have relatively less experience.

So, is there any effect of students' prior experience on a) their initial computer attitude (including anxiety), and b) the changes of attitude from Test 1 to Test 2? In order to answer this question, responses to Question 1 of the DCAS were considered.

Question 1 on the DCAS regards Computer Use, and requires subjects to indicate what sort of things they use computers for and to rank order eight alternative activities (see Appendix 2). In

an attempt to distinguish applications which involve perhaps a basic understanding or a more 'formal' use of computers from those more general, 'fun' or everyday applications, the eight alternative uses and users were categorised into four groups;

- 1: No Experience - Naive Users
- 2: Only Computer Games Players
- 3: Medium Users: Communications, Word Processing, and Instructional / Educational Programs.
- 4: High Users: Program Development, Statistical Analysis, Control, and Other.

2.3.3.1. Effects of prior experience on initial attitude

(3. Do those subjects with greater prior computing experience have more positive attitudes than those subjects who have relatively less?)

The means and standard deviations for all computer attitude scales, collapsed over all three years, for each of the four computer experience groups, and for the initial test (Test 1) only, are presented in Table 2.4.

Table 2.4. Initial attitude scores. Means and Standard Deviations of Computer Anxiety, Computer Confidence, Computer Liking, and DCAS scores, over all three years collapsed together, for each of the four groups of computer experience (1, 2, 3, and 4) separately, and on Test 1 only

Test 1	All three academic years collapsed together			
	Naïve users (1)		Games players only (2)	
	N = 31		n = 21	
	Mean	StDev	Mean	StDev
Anxiety	39.90	12.14	44.38	11.47
Confidence	40.74	11.32	41.38	7.78
Liking	40.06	11.81	40.14	9.15
DCAS	59.74	12.81	60.42	8.90

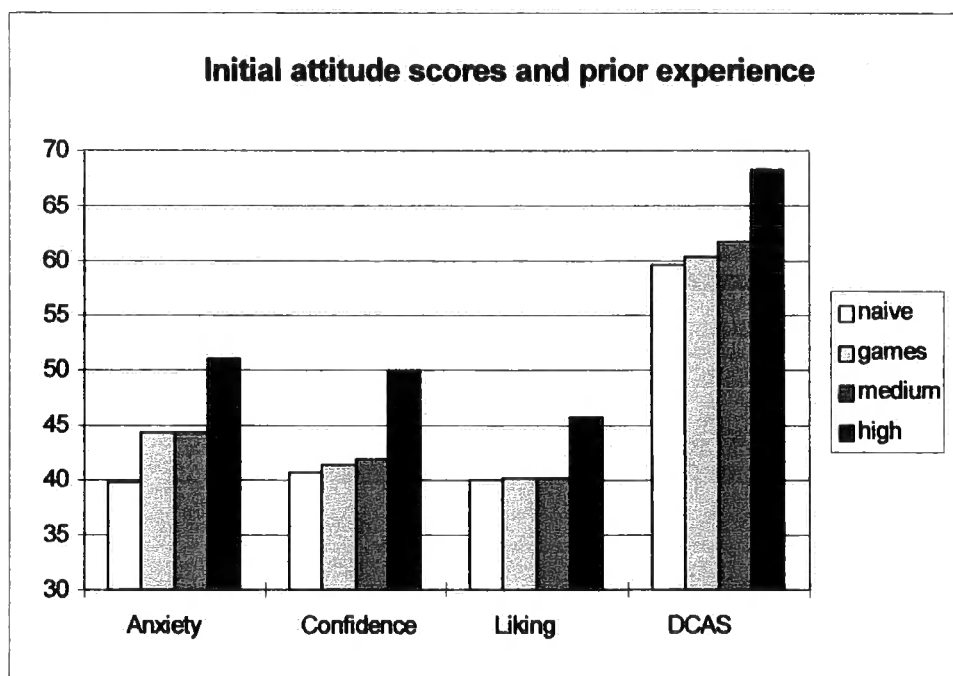
Table 2.4 cont.

Test 1	Medium users (3) N = 138		High users (4) n = 132	
	Mean	StDev	Mean	StDev
Anxiety	44.31	11.24	51.04	12.87
Confidence	41.94	8.85	50.03	12.31
Liking	40.19	9.67	45.72	11.68
DCAS	61.70	9.86	68.35	13.62

A comparatively small number of subjects (31) were totally naive or simply game players (21). The largest number falls into the medium and high user categories.

The means for these data are also shown in Figure 2.1. Figure 2.1 suggests that high experience users have higher scores on all scales.

Figure 2.1



Separate ANOVAs were performed for Anxiety, Confidence, Liking, and DCAS.

The results for computer anxiety indicated that the main effects for computer experience were highly significant [$F(3,317)=10.71, p<0.001$].

The results of the second analysis of variance procedure, using computer confidence as the dependent variable, also produced a highly significant main effect for computer experience [$F(3,317)=15.50, p<0.001$].

The results of a third analysis of variance procedure, using computer liking as the dependent variable, indicated a statistically significant effect too [$F(3,317)=7.25, p<0.002$].

Finally, the results of a fourth analysis of variance procedure, using DCAS as the dependent variable, also indicated a significant effect for computer experience [$F(3,317)=9.84, p<0.001$] (see Table 2.4 and Figure 2.1).

Thus, the ANOVAs show that there *is* an effect of prior computer experience on initial subjects' attitudes (i.e. on Test 1 - at the beginning of the academic year and before any computer interaction).

The source of the differences for all four ANOVAs was examined using Bonferroni tests for multiple comparisons. As suggested by Table 2.4, Figure 2.1, and Bonferroni tests, only the 'high' experience group of computer users was significantly different from any of the others.

(Significance found in the ANOVAs is only due to the 'high' group). It differed from all other groups in Confidence and DCAS. The 'high' group also differed from naive and medium users for Anxiety and Liking dimensions but not from the games players. This latter may be due to the small size of the games group. However, if test such as Duncan new multiple range test is used, then game players group is also significantly different from the high experience group.

Those with a good deal of computing experience, including programming and statistical analysis, had more positive attitudes. However, interestingly, moderate amounts of prior experience, such as game playing, word processing, and educational programmes, did *not* differ significantly from novice users.

2.3.3.2. Effects of prior experience on attitude change

(4. Is prior computer experience related to changes of attitudes from *before* to *after* a computing course?)

The question under investigation here is: Is computer experience related to changes of attitudes from Test 1 to Test 2? The expectation was that subjects with greater prior experience would report different attitude changes than those subjects who have relatively less experience. This expectation was formed because it was thought that prior computer experience would not only play an important role in affecting initial computer attitudes but also have an impact on the magnitude of any attitude change.

The means and standard deviations of scores for all computer attitude scales, for all four groups of experience, for all subjects as Paired Samples, collapsed over all three years, and for both Tests (i.e. 1 and 2), are presented in Table 2.5.

Table 2.5. Initial and final attitude scores. Means and Standard Deviations of Computer Anxiety, Computer Confidence, Computer Liking, and DCAS scores, over all three years collapsed together, for each of the four groups of computer experience separately, and for all subjects as 'paired samples' on the two different occasions, Test 1 and Test 2.

Naïve users (1) N = 18				
	Test 1		Test 2	
	Mean	StDev	Mean	StDev
Anxiety	38.72	12.23	43.38	13.84
Confidence	38.66	12.23	40.11	14.27
Liking	38.55	12.43	38.11	10.72
DCAS	57.77	12.71	58.88	11.84

Games Players only (2) N = 11				
	Test 1		Test 2	
	Mean	StDev	Mean	StDev
Anxiety	43.63	11.82	45.27	11.56
Confidence	42.54	6.20	41.00	8.08
Liking	41.45	7.92	35.36*	10.23
DCAS	62.27	9.22	60.54	12.50

Medium users (3) N = 74 (71 for DCAS)				
	Test 1		Test 2	
	Mean	StDev	Mean	StDev
Anxiety	44.41	12.23	43.98	12.82
Confidence	41.95	9.01	40.62	10.31
Liking	40.90	11.09	34.54*	10.08
DCAS	62.14	10.47	58.76*	13.15

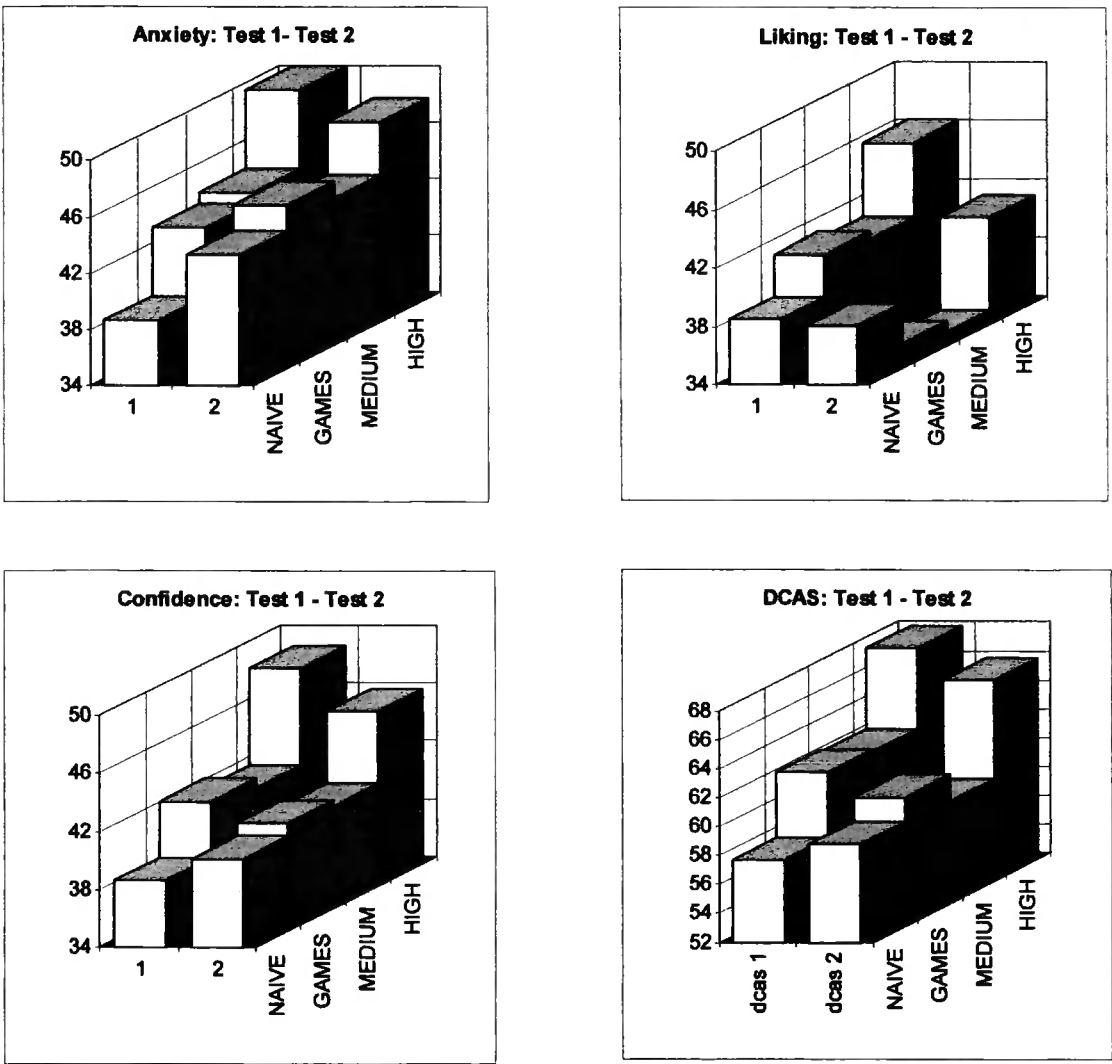
High users (4) N = 67 (63 for DCAS)				
	Test 1		Test 2	
	Mean	StDev	Mean	StDev
Anxiety	50.04	13.37	47.76ms	12.88
Confidence	48.65	12.61	45.62*	12.22
Liking	46.05	12.25	40.97*	12.85
DCAS	67.76	14.58	65.57ms	13.39

n number of subjects or pairs

* $p < 0.05$ ms (marginally significant) $0.05 < p < 0.09$

The means of the scores for all computer attitude scales (computer anxiety, computer confidence, computer liking, and DCAS), collapsed over all three years, for all four computer experience groups of subjects, and for both tests (Test 1 and Test 2), are also presented in Figure 2.2. [As before, note that these data are based on the same subjects (Paired Samples) on the two different occasions: Test 1 and Test 2].

Figure 2.2. Changes of computer attitudes (as measured by CAS and DCAS) over the academic year as a function of prior experience.



As before, it is suggested by Table 2.5 and Figure 2.2, that in the case of high experience users, the means indicate that, as a whole, their attitudes towards computers are positive to very positive (more positive for Test 1 than for Test 2) and the most positive when compared with every other group of computer experience. However, all means of 'high' users' attitude scores show marked decreases from Test 1 to Test 2. A similar tendency can be seen in medium users. In contrast, naïve users remain stable and possibly improve.

MANOVA (Multiple Analysis of Variance) procedures were used to assess the impact of computer experience on change of computer attitudes. Here the interest was in the possible interaction between experience groups and changes between Test 1 and Test 2. The dependent variables were changes in computer anxiety, computer confidence, computer liking, and DCAS. The independent variable was computer experience as defined by the four groups (1, 2, 3, and 4). A multiple analysis of variance was performed for each dimension, with 'time' as a repeated factor.

Only in the case of computer anxiety as the dependent variable, there was a marginally significant interaction between group and time [$F(3,165) = 2.34, p < 0.075$].

In the light of this evidence and in considering Figure 2.2, selected repeated measures two-tailed t-tests were performed for Computer Anxiety (high and naïve users), Computer Confidence (high users), Computer Liking (games players, 'medium', and 'high' users), and DCAS ('medium' and 'high' users) scores in order to assess whether the scores on Test 2 were significantly lower than on Test 1 (see Table 2.5).

a) For computer anxiety, the analysis revealed that the decrease of the score was marginally significant only for the high experience group. b) For computer confidence, the decrease of the score was also significant for the 'high' users. c) For computer liking, it was revealed that scores decreased significantly in all experience groups except the 'naïve' users. d) Finally, for the DCAS scores the decrease was significant for 'medium' users, and marginally significant for 'high' users. It should be noted however that the smaller size of the naïve and games playing groups would reduce the likelihood of significance being achieved.

2.3.4 Reported attitudes on DCAS

Questions 8 and 9 on the DCAS (Part II) ask subjects to provide examples of the experiences which, in their opinion, have led to particularly positive and/or negative attitudes/feelings about using computers (see Appendix 2). The responses to these questions have been further categorised into: 1) those experiences, adjectives or opinions which relate to the computer - [COMPUTER], and 2) those that relate more to personal ability or feelings - [PERSONAL].

This was done by firstly deciding if a response was positive or negative (in many cases there were both positive and negative feelings), and then it was considered if the responses (positive or negative) were mainly attributed to the computer itself or to each individual's personal biases or abilities. In some cases, for example, such as computer negative, if the respondent found the machine unreliable, this was regarded as computer related rather than personally affective, although to some extent this is a fine distinction. The coding was done by the researcher. The purpose of these questions and results was to collect supplementary qualitative

information about the subject and his/her experiences and/or feelings about computers in order to provide additional information about the origins and qualities of his/her computer attitudes and attitudes' change.

The data are not suitable for statistical analysis since what is shown is summed frequencies that are not independent. It should also be noted that answering these questions is optional – and not all participants chose to give responses. Further, there is a marked drop in frequency of response from first to second occasion, which could be due to reduced compliance for example. Despite these reservations, the following results are suggestive.

The frequencies of these responses, for all 'paired' subjects (n=102), for each of the two tests (Tests 1-initial and 2-final), and for all three years together, are presented in Table 2.6a and 2.6b. (Note that these data are based on the same subjects on the two different occasions, and the sample is the same on Test 1 and Test 2).

SUMMARY OF THE EXPERIENCES WHICH HAVE LED TO PARTICULARLY POSITIVE OR NEGATIVE FEELINGS ABOUT USING COMPUTERS

Table 2.6a. Frequencies of positive responses (DCAS, page 2) for subjects as 'paired samples' over all three years collapsed together (n = 102)

COMPUTER POSITIVE	initial	Final	PERSONAL POSITIVE	initial	final
Useful for -			Confidence in being able to		
Accessing data			control the computer	6	2
Communications			Increasing confidence		
Word processing			after a period of use	6	4
Statistical analysis	19	15	Finds them easy to use	7	3
e-mail	1	4	Satisfaction of achievement	8	10
Good presentation of work	4	3	Challenging	1	0
Versatile	2	0	Enjoyable	11	5
Time saving / convenient	11	8	Fascinating	2	0
Makes work more interesting	1	1	Wants to/ willing to learn	7	3
			Helps in getting a job / money	4	1
			Good access to facilities	2	1

In considering initial responses to DCAS (Test 1), on the 'Computer Positive' section, subjects attributed their (positive) feelings and attitudes towards computers most commonly to the usefulness of computers in word processing, communications, statistical analysis, and accessing data [the frequency of this response was 19 (n=19)]. Second most frequent attribute (n=11), for the 'Computer Positive' section, was that computers were perceived to be convenient and time saving. In addition, as a third attribute, computers were described to be essential for good and tidy presentation of students' work (n=4). It should be pointed out that on Test 2 the numbers of responses reported above were slightly reduced with the exception of the response of perceived usefulness of the electronic mail, which was increased.

In considering initial responses to DCAS on the 'Personal Positive' section, subjects reported as attributes of positive attitudes, enjoyability (n=11), satisfaction of achievement (n=8), ease of use (n=7), and confidence (n=6) when working with computers. However, the perception that computer knowledge can improve students' chances in getting better jobs and earning more money, was rather infrequent (n=4). Most of the frequencies of these feelings about computers were reduced on Test 2, except the frequency of 'satisfaction of achievement' when working with computers explanation, which was slightly increased (n=10).

In general, on the positive scale, respondents are just as likely to mention usefulness of computers for application after as before, but most other aspects lead to fewer comments – in particular there is a diminution in comments about confidence.

Table 2.6b. Frequencies of negative responses (DCAS, page 2) for subjects as 'paired samples' over all three years collapsed together (April / May 91, 92, and 93 n = 102)

COMPUTER NEGATIVE	initial	final	PERSONAL NEGATIVE	Initial	final
Problems with			Apprehensive	7	1
Programming/ printing/	10	4	Stressful	2	1
Loading			Annoying	3	2
faults/ crashing/losing work	11	14	Tiring / headache	4	
Boring	13	5	Fear	6	2
Tedious	9	4	Confusing	6	4
Unreliable	1	1	Don't understand	12	11
Frustrating	7	5	Complex	11	12
			Helplessness / out of control	8	5
Computer limitations			Negative feelings - due to lack		
(e.g.) lack of built in advice	8	6	of experience and knowledge	5	4
			Limited (egg) keyboard skills	2	1
Time wasting / consuming/	9	7	Limited / poor teaching -	11	10
Takes longer			Rushed in sessions	2	4
			Lack of available help & advice	4	7
Necessary / obligatory	2	2			
			Ignorance	8	3
			Addictive	1	
			Limited access to facilities		1
			Put off by image of 'computer		
			addicts' and 'computer talk'	10	7
			Intimidated by friends who know		
			more		

In considering initial responses to DCAS (Test 1), on the 'Computer Negative' section, subjects attributed their (negative) feelings, experiences, and attitudes towards computers most commonly to loss of work due to computer crashing, and problems with programming / printing (numbers of responses 11 and 10 respectively). In addition, computers were frequently perceived to be boring (n=13), tedious (n=9), time wasting (n=9), and frustrating (n=7). However, on Test 2, most of these numbers of responses were reduced, except the frequency of the 'computer crashing and losing work' problem, which was slightly increased.

Finally, in considering initial responses to DCAS on the 'Personal Negative' section, subjects reported, as reasons for negative computer attitudes, incomprehensibility (n=12) and complexity of computers (n=11), limited and poor teaching (n=11), helplessness and loss of control when working with computers (n=8), and perception of the machines and their operation as apprehensive (n=7), confusing (n=6), and fearful (n=6). Students also attributed negative attitudes to ignorance (lack of computer knowledge - n=8), and intimidation by friends who know more about computers. Most of these frequencies of responses were reduced on Test 2, except the frequencies of incomprehensibility and complexity, that remained on similar to Test 1 levels, and frequencies of complaints about limited / poor teaching and lack of help and advice that remained high or increased.

In general, for negatives, experience seems to reflect concern with faults and problems with availability of facilities and instruction. The category of negative feelings is large, but does not appear to have been modified by the year's experience. It should be stressed however that these data can only be regarded as suggestive.

2.4 Discussion

In general, the results of this study relate to its aims as follows:

1. The first research question was: What are students' attitudes (including anxiety) towards computers?

The present results indicate that students' attitudes towards computers, as measured by CAS and DCAS, were neutral to (slightly) positive at start. By the end of the academic year, students' attitudes towards computers, although less favourable than the beginning of the academic year, were still neutral to slightly positive. An exception was computer liking, as measured by the respective CAS subscale, where students' responses were on average slightly negative at the end of the academic year.

2. The second research question was: Do students' attitudes towards computers change significantly as a result of several training sessions on computers?

The present results show that students' attitudes towards computers in general did change significantly from the beginning to the end of an academic year as a result of computer training together with general experience and use of computers throughout an academic year. As measured by the CAS subscales, although computer anxiety did not change significantly, confidence decreased significantly, and liking decreased highly significantly. Attitudes, and in particular computer liking, as measured by the DCAS, also decreased significantly and shifted to be less favourable.

3. The third research question was: Do those subjects with greater prior experience have more positive attitudes than those subjects who have relatively less?

The present results indicate that subjects (students) with greater initial computer experience did have more positive initial (i.e. at the beginning of the academic year) attitudes, than those subjects with relatively less experience. This was true for computer anxiety, confidence, and liking, as measured by CAS, and general attitude / computer liking, as measured by DCAS. However, the only experience group that had significantly different (more favourable) initial attitudes than any other group was the one of the high experience users.

It appears that only a lot of prior computer experience can positively affect computer attitude. However, this may be the result of 'self-selection' of the sample, and high users could be a self-selected group, i.e. students may do extra things with computers because they like them and because of their positive attitudes towards them.

4. The last question was: Is prior computer experience related to changes of attitudes from before to after a computing course?

The present results show that initial computer experience did relate to changes of attitudes from Test 1 to Test 2. Those subjects with greater prior computing experience actually had more/higher attitude changes than those subjects who had relatively less experience. In particular, the high experience group differed significantly from initial to final attitude in confidence and liking, as measured by CAS, and marginally significantly in anxiety (CAS) and attitude as measured by DCAS (mainly computer liking). The medium experience group changed their attitude significantly only for computer liking and DCAS. Games players changed only for liking, and naïve users, despite of their change in anxiety, showed no significant shift of attitude, probably because of their sample size.

In the case of naïve users, there may be a slight suggestion that their computer anxiety decreases (and, thus, their attitude improves) from Test 1 to Test 2. Although the absence of significance may be due to their small sample size, this absence makes it difficult to conclude that the naïve group shows a definite improvement of attitude.

The results from this study indicated that students as a group exhibited neutral to slightly positive attitudes towards computers. One of the main hypotheses of this study was that all scores on the attitude scales would be higher on Test 2 than on Test 1 (though the effect might be small or zero with experienced users). However, all scores, except that for Anxiety, decreased significantly on Test 2, contradicting the original hypothesis. This confirms Rosen

et al's (1987) study but conflicts with the results of other researchers reviewed in the Introduction (e.g. Gressard and Lloyd, 1985; Harrington et al, 1990; Brown and Coney, 1994; and Czaja and Sharit 1998). It also negates Woodrow's (1994) findings, that gains in computer attitudes were independent of computer training. In Woodrow's (1994) view, it is the users' unstructured computer experiences, based on the users' current computing needs (e.g. in word processing), that mainly accounts for the improvement of computer attitudes and reduction of computer anxiety.

So, the results of this study contradicted the original hypothesis that structured computing experience (gained within a type of computer course over a few months' period) would result in improvement of students' attitudes (including lower levels of anxiety) towards computers. These results were consistent with the hypothesis that computing experience produces more positive attitudes towards computers, but this involved only the computing experience that was gained prior to this study, and only for the high experience group.

Perhaps this finding is not consistent with the suggestion by Marcoulides (1988) that non-threatening, less stressful computer applications be introduced in order to reduce computer anxiety and improve computer attitude; as one would assume that for most people programming would be more stressful than, for example, word processing. However, this finding suggests that the nature of computing experience is important in leading to a particular computer attitude.

The present results revealed that the higher the (prior) computer experience (as defined by the four groups), the highest the initial attitudes, and the highest the decrease of attitudes towards computers on Test 2. The latter may have been because the higher the computer experience the subjects had, the more were their expectations from the teaching, help, and advice within a computer course, and the more may have been the discrepancy between their expectations and the actual teaching, help, and advice, as well the actual computing sessions they had. Similarly, the more the computer experience the students had, the more the rigidity and resistance they may have had to learn a new computer operating system and new knowledge about computers. A parallel might be drawn with Mandler's (1975) view of the interruption of plans.

For example, the discrepancy between 'high' users' expectations and actual computer sessions was greater than the same discrepancy for 'medium' users, game players, and especially 'naive' users who had no contact with computers before these sessions. Thus, 'high' users' decrease of attitude scores was the highest, with 'medium' users' decrease of attitude scores having been lower, game players' lowest, and with no significant decrease for the 'naive' users.

In considering all subjects together, as well as each experience group separately, on Test 2, there was no significant decrease of the score for computer anxiety except only for the 'high' users where the decrease of anxiety score (indicating increased levels of anxiety) was marginally significant. This result conflicted with most of the results of other researchers reviewed in the Introduction, who suggested that computer experience can reduce the levels of computer anxiety.

This study also analysed the subjects' explanations and experiences that they think led them to feel in a particular way or to have a specific attitude towards computers. The most common theme amongst subjects' reasons for positive attitudes was that computers are useful for a variety of applications and the second most frequent one was that computers can be very much convenient and time saving. According to many subjects those factors make computers enjoyable and giving a strong sense of satisfaction of achievement.

This result is consistent with Rubin (1983) who suggested that prospective users are attracted to the benefits of the computer, such as time savings and accuracy of output, but are afraid that the computer will 'take over' and they will ultimately lose control. So, on the other hand, and similarly to Rubin's findings, subjects in the present study reported that they could lose their work by accidentally pushing the wrong button.

Other frequently mentioned negative issues (reasons for negative attitudes) were that 1) computers can be time wasting and more time consuming than pen and paper; 2) programming as well as jamming printers and technical faults can be serious problems; 3) ignorance, lack of computer experience/knowledge, and lack of understanding make various computer issues far too complex and difficult. Also, some of the subjects have reported that teaching of computing had been poor and limited both within their previous experience and in Psychology Department, computer sessions were rushed, and there was lack of appropriate available help and advice (Test 1: n=17, 17% of responses; Test 2: n=21, 21% of responses approximately).

Finally, some subjects found computers, computing, and computing lessons tedious, boring, frustrating, confusing, tiring, and apprehensive (Test 1: 46% of responses; Test 2: 19% of responses). In addition, some of them reported that computers gave them a decreased sense of control and an increased feeling of helplessness. (Test 1: 8%; Test 2: 5%).

In general, within the limits of this study, results indicate that prior experience is related closely to attitudes towards computers; however, no causal relationship can be assumed.

In the light of the present results, the issue then becomes a question of how much these results are generalisable. Ansley and Erber's study (1988) assessed older adults' attitudes towards computer technology, tested the effect of computer interaction on attitudes towards

computer technology, and compared older adults' performance (time and errors) and cautiousness on a cognitive task presented via computer versus paper-and-pencil formats. In an initial session, 60 older adults completed Wagman's (1983) Cybernetics Attitude Survey (CAS). Their CAS scores were compared with those of a young adult group. In a second session the 60 older adults were randomly assigned to one of three treatments: cognitive computer, cognitive paper-and-pencil, and fun computer. The CAS was administered again immediately following the treatment intervention.

Statistical analyses indicated that older adults' pre-treatment CAS attitude scores were not significantly different from the attitude scores of young adult undergraduates. The treatment intervention had no significant effect on the older adults' computer attitudes, which remained consistent with pre-treatment levels. A comparison of number of errors and time needed by older adults in the cognitive computer and cognitive paper-and-pencil treatment groups indicated no significant difference. Similarly, the degree of cautiousness exhibited by the two groups as measured by betting strategy was no different. According to Ansley and Erber, while further research with different tasks and a broader segment of the older adult population is necessary, their results did not support the stereotype of older adults as resistant to computer technology or as experiencing difficulty in using this technology (Ansley and Erber, 1988).

Finally, in Marcoulides et al's (1995) study, covariance modelling techniques were used to test the assumption of group invariance of a computer anxiety scale by comparing results from two potentially different populations: college students and members of a law enforcement agency. Results provide strong support for the hypothesis that the validity of the computer anxiety construct could be generalised to different groups.

Coming back to the present study, it is unfortunate that the return rate of questionnaires from 91-92 academic year students for Test 2 was not higher as the results of this study would have provided an excellent comparison and replication of the 90-91, and 92-93 academic years study. However, even by having considered only the existing data, results from 91-92 revealed a similar pattern of attitude change with results from 90-91 and 92-93, whereas existing data are complete.

Another issue is that this investigation studied changes in attitude over a relatively short time period. Further studies could follow up the existing findings by testing subjects within the second or third year of their studies. Since, in the light of present results, those subjects with greater prior computing experience had more/higher attitude changes than those subjects with relatively less experience, computer attitudes and anxiety may be less resistant to change after a certain amount of experience.

Finally, the use of a control group was considered at the beginning of this research. Ideally, a control group would consist of a number of psychology students who, over their first year in the university, did not have a computing course. Their change of attitude from the beginning to the end of the academic year could have been then compared to students who **had** such a computing course. However, the proliferation of computer technology in the University made it an unrealistic task to find science or social science students who were not gaining any computer experience during that period.

One possibility would be to use a group of Arts and Humanities students. However, although these students may have not received any structured computing sessions within the university, it would not be possible to assume that they had no other computing experience in a non-structured form within or outside the university. In this case, the comparison for the attitude change would be between a group who received structured computing sessions and a group who had non-structured computing experience during the same period of time.

What was decided instead was to use different levels of *prior* experience to approach the problem. Such a 'parametric' approach could give some indication of the effects of different 'dose levels' of experience on computing attitudes, stress and performance. This approach also has the virtue of going some way towards combining two different aspects of the literature, where studies have either tended to investigate effects of prior experience (e.g. Levine et al, 1997, 1998; Loyd, Loyd, and Gressard, 1987; Todman and Monaghan, 1994; Maurer, 1994; Rosen and Weil, 1995; Ray and Minch, 1990; Marcoulides, 1988; Heinssen et al, 1987; etc) or looked at effects of computing sessions (e.g. Harrington et al, 1990; Czaja and Sharit, 1998; Brown and Coney, 1994; Woodrow, 1994; Gressard and Loyd, 1985; Igbaria and Chakrabarti, 1990; Rosen et al, 1987; McInerney et al, 1994; Leso and Peck, 1992; Koslowsky et al, 1987; etc).

Note that Appendix Thirteen provides an update of current related research and a summary of recent supplementary information.

CHAPTER THREE

Computer stress, performance, experience, and attitude

3.1 Introduction

3.1.1 Introductory conceptualisation of stress in computing

The effects of computers on the health of the operators have been studied from several different points of view from the latter half of the 1970's to date. In reviewing the literature and as a result of these studies, five main areas seem to be apparent: 1) Effects on visual function, such as irritated eyes, blurred vision, burning eyes, and eye strain (e.g. Grandjean, 1984). 2) Effects on muscles, such as painful and stiff neck and/or shoulders as well as back pain (e.g. Smith et al, 1981a). 3) Effects caused by non-ionising or ionising radiation emissions (e.g. Kuhmann, 1987). 4) Skin disorders caused by the combined effect of airborne chemical contaminants in rooms and static electricity generated by computer screens (e.g. Grandjean, 1987). 5) Effects towards mental fatigue, stress, strain, and psychosomatic reactions. It is the last of these that is of concern here.

Thus, computer technology has placed additional demands on people. Some of them may experience difficulties in dealing with these demands and may experience stress; Brod (1984) has called this type of stress "technostress". According to Brod (1984)

"Technostress is a modern disease of adaptation caused by an inability to cope with the new computer technologies in a healthy manner".

In general, Brod (1984) offered clinically derived descriptions of technostress, but no measure of it.

The term "technostress" could be operationally defined in several ways and allow for stress reactions to be considered as similar to anxiety reactions or even as attitudes. One approach might include the assessment of potential stressors; another might assess 'pathological' reactions to stressors; another might view stress as a 'state' anxiety concept as opposed to anxiety as a trait; while a fourth might even measure attitudes towards computer technologies.

Concern has certainly been raised regarding the stress effects of introducing and applying computer technology into the office workplace. This was because computer-mediated work has altered several job and organisational factors related to stress and health in general (Briner and Hockey, 1988; Amick and Celentano, 1991; Smith, 1987); those factors include workload, job control, task content, interpersonal relations, etc. However, a review of the job stress literature showed little evidence of a direct association between computer-

mediated work and stress-related illness or disease (Amick and Ostberg, 1987; World Health Organisation, 1987).

3.1.2. Hudiburg's studies on the relation between computer attitude/anxiety and stress, and the relation between computer stress and experience

Hudiburg (1989), influenced by Brod's work on 'technostress', developed the Computer Technology Hassles Scale to measure computer-related sources of stress. The Computer Technology Hassles Scale was based on the idea that certain interactions with computer technology are perceived by people to be stressful or a 'hassle'. The hassles were considered as forms of frustrations that computer users commonly have.

According to Kanner et al (1981)

"daily hassles are the irritating, frustrating, distressing demands that to some degree characterise everyday transactions with the environment".

Kanner et al's scale has received empirical support as relating to somatic complaints and health-related problems (DeLongis, Coyne, Dakof, Folkman, and Lazarus, 1982). The scale used in Hudiburg's study (1989) was actually patterned after the Kanner et al's (1981) Daily Hassles Scale. According to Hudiburg "a computer hassle is a stimulus which may come to be viewed as a stressor, given its effect on the individual".

The scale was developed by generating a list of "computer hassles", using instances of contact with common computer technology, use of computers, computer-generated information, and the impact of computers in society. To derive this list, the author consulted several popular treatments of computer-phobia (e.g. Hellman, 1976; Shore, 1985; Weinberg, 1985), conducted interviews with new users of computers, and used personal experiences with computers. The result was a list of 65 "computer hassles".

The Computer Technology Hassles Scale was scored in three ways. First, the number of hassles the subject responded to was determined; second, a total severity score was derived by summing the severity for those items checked; third, an intensity score was defined for each subject by dividing the total severity score by the total number of hassles. These scores were similar to those defined on the Daily Hassles Scale developed by DeLongis et al (1982).

Subjects (141 undergraduate and graduate students in a US university) rated this list as to severity, using a graded response. To ascertain the relation of the Computer Technology Hassles Scale to other measures, the subjects were given the Perceived Stress Scale (PSS, Cohen et al, 1983), a measure of global stress. In addition subjects were given a measure of

computer attitudes, the Computer Attitude Scale (Nickell and Pinto, 1986). Demographic data on each subject were also collected.

In considering Hudiburg's results, the reported Perceived Stress Scale mean score indicated that subjects perceived moderate stress; only a few subjects reported high stress. Also, within the Computer Technology Hassles Scale, the intensity mean score indicated that those students who perceived hassles rated them as moderately severe.

Correlational analyses showed that the number of hassles and severity scores from the Computer Technology Hassles Scale were highly correlated; these two measures were found to be non-independent, so it was decided that only the number of hassles was to be used in further analyses with other variables. On the other hand, the intensity score correlated only moderately with the number of hassles.

Scores on the Computer Technology Hassles Scale were also significantly correlated with scores on the Perceived Stress Scale (PSS); that may have indicated that computer hassles can be stressful. In addition, the Perceived Stress Scale scores were correlated negatively with the Computer Attitude Scale; so, those who perceived more stress in general, as measured by Cohen et al's PSS, tended to experience more hassles with computers, and also tended to have slightly more negative attitudes towards computers.

Also, Nickell and Pinto's (1986) Computer Attitude Scale score was positively correlated with the number of hours of computer use or vice versa. Similarly, the number of hassles responded to was positively correlated with number of hours of computer use. This suggested that the more people used computers, the more likely they would experience a hassle; and the more the 'hassles' the subjects had, the more likely they were to score higher on stress.

However, Hudiburg's 'hassles' measure of computer-related stress was found to be relatively independent of attitudes towards computers (Hudiburg, 1989). In other words, it was apparent that a person's attitude towards computers was not related to the perception of computers as being a hassle. This was an interesting result which suggested that, if a person experiences stress when dealing with computer technology, it has little to do with attitudes towards the technology.

Thus, Hudiburg's (1989a) measure of computer-related stress, the Computer Technology Hassles Scale, was shown to be related to a global measure of stress (the PSS, Cohen, Kamarck and Mermelstein, 1983) but relatively independent of attitudes towards computer technology (as measured by the Computer Attitude Scale, Nickell and Pinto, 1986). In a second study, Hudiburg (1989b) revised the Computer Technology Hassles Scale and found that the scale was related to global stress and somatic complaints. However, the scale was not related to computer attitudes or a measure of computer anxiety (Oetting, 1983). So, in

conclusion, these two studies have initially demonstrated that the Computer Technology Hassles Scale is a measure of a specific type of stress and that this computer-related stress is separate from attitudes towards computers and computer anxiety. According to Hudiburg "computer-related stress results from interactions with computer technology".

At this point, the relationship between computer-related stress and 'computerphobia' will be briefly considered. Computerphobia, as seen before, may be considered as an extreme form of computer anxiety. In particular, and as discussed in Chapters 1 and 2, interest in human-computer interactions has spawned many constructs about these interactions. These concepts may seem at a glance to be similar or related but are possibly operationally distinct. Computer anxiety or computerphobia is one of these constructs and has been characterised as fear of or resistance to computer technology. Measures of 'computerphobia' were developed by Rosen, Sears, and Weil (1987). Since both computer-related stress and 'computerphobia' are by-products of human-computer interactions, it would be of value to learn the relationship between the two. Hudiburg's 1990 study was conducted to investigate the relationship between the Computer Technology Hassles Scale, a measure of computer-related stress (Hudiburg, 1989), and 'computerphobia' as defined and measured by Rosen et al (1987).

In this study, firstly, a questionnaire was constructed which included demographic questions (sex, age, etc) and questions about exposure to computers, e.g. years of computer use, computer knowledge, etc. Secondly, two scales from a previous (1989) Hudiburg's study were included: one was the Computer Technology Hassles Scale and the second scale consisted of the somatic complaints items from the Hopkins Symptoms Checklist (Derogatis, Lipman, Rickels, Uhlenhuth, and Covi, 1974). Thirdly, three scales were included from the Rosen et al (1987) study of computerphobia: the Computer Anxiety Rating Scale, the Attitudes Towards Computers Scale, and the 28-question Computer Thoughts Scale. Finally, a self-rated seven-point computer knowledge scale was also used (Hudiburg, 1990).

All questionnaires were administered to a sample of 109 undergraduate and graduate students enrolled in psychology and business courses at a south-eastern USA university.

Firstly, students who had taken a computer course differed significantly from those who had not taken a computer course on the Attitudes towards Computers Scale (Computer Attitude mean scores 89.8 vs 84, respectively, in a 26-item scale with total scores ranging from 26 to 130). Also, contrasting those who currently used a computer, to those who did not, yielded significant differences on all three computerphobia measures (Computer Anxiety Rating Scale, Attitudes towards Computers Scale, and Computer Thoughts Survey), with computer users having less anxiety, more positive attitudes, and less negative thoughts about computers.

Secondly, correlations indicated that scores on the Computer Technology Hassles Scale were significantly correlated at 0.35 with somatic complaints, 0.27 with years of computer use, and 0.28 with self-rated computer knowledge. However, the Computer Technology Hassles Scale was NOT significantly correlated with Rosen et al's (1987) measures of 'computerphobia' (Hudiburg, 1990). So, the lack of correlation between the measure of computer-related stress and measures of computerphobia provided evidence for differentiating the construct of computer-related stress, as measured by the Computer Technology Hassles Scale, from 'computerphobia' as measured by Rosen et al (1987), i.e. the 'computer-related stress' concept appeared to be distinct from that of 'computerphobia'.

In Hudiburg's (1990) view, since the Hassles Scale correlated with psychosomatic problems, computer experience, and computer knowledge, these results provide additional support for his Computer Technology Hassles Scale as a measure of computer-related stress. In addition, the experienced stress seems to be a result of human-computer technology interactions (computer technology 'hassles') and is associated with increased somatic complaints.

The issue of prior experience and amount of computer use, both in relation to stress, come up in a subsequent study. Ballance and Ballance (1996) examined the relation between computer-related stress and amount of experience. In their study, 57 college students were surveyed using Hudiburg's revised Computer Technology Hassles Scale. From additional information, groups with various amounts of experience were formed. The results were similar to previous findings in that the more people used computers, the more likely they would experience a hassle; and the more the 'hassles' the subjects had, the more likely they were to score higher on stress. However, amounts of previous computer experience were found to be negatively correlated with levels of stress; and in general, computer-related stress was found to be not simply a by-product of increased interaction with computers. The authors suggested that further studies should consider more factors influencing computer-related stress.

Finally, in 1996, Hudiburg and Necessary investigated coping strategies used by computer users who experienced varying degrees of computer stress. In this study, 83 college student computer users completed a research questionnaire with information about computer use, computer knowledge, level of computer stress, somatisation/anxiety, stressful computer problems, self-esteem and use of coping strategies. Based on scores derived from the Computer Hassles Scale, the students were classified as either experiencing high or low levels of computer stress.

Statistical analyses of differences revealed that users showing high computer stress had lower self-rated computer abilities, reported higher levels of somatisation and anxiety, and had lower self-esteem. Users showing high computer stress, in contrast to users showing low computer stress, significantly employed at higher levels confrontive, self-controlling, and accepting

responsibility coping strategies in dealing with computer problems. The coping strategies employed by high computer stress users were primarily emotional-focused coping strategies. The low computer stress group tended to adopt a problem solving coping strategy in dealing with computer problems.

One of the important findings in Hudiburg's studies, that is relevant to the present investigation, is that people who have more experience with and knowledge of computers tend to experience more computer-related stress. This finding confirms with the notion of exposure, i.e. the more people are 'exposed' to interaction with computers the more likely they are to experience more 'hassles' and consequently more computer-related stress; within this context, for example, someone who has never interacted with a computer, obviously will not be expected to have experienced either computer-related hassles or stress.

3.1.3. Experience as a moderator of computer stress: Dolan and Tziner's study

Resistance to the shift from the industrial era to the information society has been clearly documented. Technological changes such as the introduction of computer-based office automation have been recognised as a source which may induce the experience of stress (e.g. Tosi, Rizzo, and Carroll, 1986).

An important issue within this context is the question of what in the technological change it is that generates stress. It appears reasonable to assume that the ambiguity and the uncertainty about performance expectations, likely to emerge from the change, carry the intermediate role of exacerbating organisational stress (e.g. Kemery, Bedeian, Mossholder, and Touliatos, 1985; Dolan and Tziner, 1988). However, in accordance with Beehr and Newman (1978), previous exposure to and experience with implementations of automation in the office can mitigate possible adverse outcomes from office computerisation, such as feelings of losing control over the job.

Thus, Dolan and Tziner's study (1988) focused on the impact of previous experience with office automation implementations on experienced stress associated with different work aspects, following the introduction of computer-based office automation. One hundred and ninety-one full-time secretaries at a large university in Canada completed questionnaires related to stress perception and prior experience with office automation. Results indicated that those without previous experience reported higher levels of experienced stress associated with work content aspects such as task difficulty and interest in the task, whereas those with prior experience reported greater problems with contextual aspects such as training and instruction.

In particular, in Dolan and Tziner's study, the computer-based automation of the office consisted of (1) switching from non-electric typewriters to the use of word-processors for any material typing, and (2) turning from hand-documenting information on students and faculty members in regular dossiers to the utilisation of (micro)computers for keeping records (e.g. personal files, academic achievements, etc).

The results of Dolan and Tziner's study indicated that, in general and for all subjects, highest stress levels were associated with aspects of wages, job security, health and safety, and training. On the other hand, least stress was associated with task difficulty, career path, and autonomy. However, those subjects without previous experience reported significantly higher experienced stress with regard to aspects such as task difficulty, work autonomy, health and safety, and career path. On the other hand, those subjects with experience showed greater experienced stress with regard to issues such as training and information.

In particular, secretaries, without prior experience with implementation of office automation, experienced stress because of a possible deterioration in the quality of their work life, as reflected by anticipation of work becoming more difficult (i.e. task difficulty), because of control over work being shifted from their hands to the computer-based devices (i.e. autonomy), and because of restriction of promotion opportunities (i.e. career path).

Meanwhile, the secretaries experienced with a prior automation change had somehow a more realistic perception of the nature of the upcoming change. Their concern (and source of stress) was over getting a proper training and information on how to operate the new technology so that they would succeed in operating the newly introduced devices.

Dolan and Tziner's study (1988) provided empirical evidence about an area of research which has been somehow understudied. Subjects evidently experienced stress associated with different occupational aspects, following introduction of the computer-based automation in the office. Perhaps, the major conclusion that may be drawn from this study is that the stressful effects of the shift to computer-based automation could be mitigated, and adaptation may be eased, by providing proper information and training programmes to those involved prior to introducing the technology change. This, in turn, may contribute to alleviate the resistance to implementation of new technologies as reported by other researchers (e.g. Coch and French, 1948).

3.1.4. Stress as not a computing specific issue: Kumashiro, Kamada, and Miyake's study

Kumashiro et al's (1989) research involved 104 employees of a software company in Japan, in order to study their stress and sources of stress at their work places. In particular, Kumashiro et

al's survey was an attempt to measure the degree of stress and factors affecting the development and growth of stress in workers involved in computerised work in a software company, in comparison with the stress in workers involved in other types of businesses (a machine shop and a petrochemical plant - data from these businesses were 'reference' data).

The measures used in this survey were the stress and arousal check list (SACL) developed by Cox and Mackay (1978, 1985), and a "Questionnaire on Work and Health" which was mainly covering issues such as feelings and attitudes about job, family life contexts, working environment, health condition, work motivation, computer-related work, etc.

Compared with the 'reference' data, it was found that the average stress score of the software workers was significantly higher than that of the people working for either of the two other businesses.

In particular, the average stress score of the 104 respondents (90 men and 14 women) working for the software company was found to be 9.2 (out of a possible maximum score of 17, and a minimum 0); standard deviation was found to be 4.04. In comparison, the average stress score of the 2,066 machine shop workers was 7.5 with a standard deviation at 3.86; whereas the average stress score of the 2,828 petrochemical plant workers was 6.8 with a standard deviation of 3.5.

Additionally, out of 104 workers within the software company, 68 people who were involved in the operation of computers daily, were selected by the researchers, and their average stress score was also calculated; it was 8.99 with a standard deviation of 3.88. The same was done with the 'reference' data from the machine shop and the petrochemical plant in order to conduct a comparative study.

The results, this time, indicated that there was no substantial difference between the average stress score of either the machine shop or petrochemical plant workers and the average stress score of the respective computer operators. No definite relationship was found either between the length of time spent on computer operation and the average stress score (Kumashiro et al, 1989).

Considering Kumashiro et al's findings, it is difficult to conclude that the level of stress scores is induced by the interaction with the computers itself. Other studies have also reported similar results. For example, Agervold's (1987) study, indicated that the incidence of mental fatigue, stress, and psychosomatic complaints was the same among those working with or without the new computer technology. Furthermore, according to Grandjean (1987), although previous studies showed that there was high stress and complaints in computer workshops due to repetitive computer tasks such as data input and data processing, the stress and strain

caused by the intensive use of computers was not significantly higher in comparison with that of a reference group of workers. In addition, Turner (1980) reported that no conspicuous relationship was found between the amount of computer use and psychological strain and job satisfaction.

Thus, people's high stress shown within the first part of Kumashiro et al's study could be interpreted to have been influenced to a great extent by other factors, such as working conditions, business environment, conditions for computers operation, etc.

Kumashiro et al's results, as well as Turner's (1980), contradict previous findings of Hudiburg's (1989) who suggested that the greater the number of hours worked on the computer, the more likely the stress of the operator/user to be greater.

Furthermore, in Kumashiro et al's study, a factor analysis of 26 work-related items was conducted, considering the 104 software workers, in an attempt to define stressors in the workplace. Those 26 work-related items were classified as six factors: job attitude, distribution of work pace, physical environment of work place, computer operation, dependency on computers, and working conditions.

In addition, a multiple regression analysis was conducted with the stress score of the SACL (Stress and Arousal Checklist) as the dependent variable, and age, duration of experience in the job, monthly overtime work hours, and the six factors as the independent variables. As a result, the stress variables which were found to have a significant correlation with the stress score (and therefore were considered to be the main stressors in the software company) were: the pace of work, overtime work hours, computer operation, and job attitude ($p < 0.001$). Also, incompatibility between the workers' ability and the nature of their jobs was found to be another source of stress (Kumashiro et al, 1989).

This result, as described before, was partly found by Cohen et al (1983), Kuhmann (1987), Barfield (1984), and Johansson and Aronsson (1980), who all suggested that stress increases when computer operators are unable to control their work at their own pace.

There are also a number of research reports claiming that the influence of paced systems on mental tension / stress of the workers was found in machine-paced work as well (e.g. Review by Cox, 1980; Kalimo et al, 1981; Smith et al, 1981, etc). Therefore, the stress sources (stressors), related to distribution of work pace among the software employees in Kumashiro et al's study, could be considered to be an important and common stressor found in jobs where workers/operators cannot maintain an independent work pace, regardless of whether or not computers are used.

Therefore, it is difficult to conclude that the development of negative moods and feelings towards a job, work overload, and overtime work are stress sources particular to software and/or computer companies.

As a general conclusion, it seems that the stressors causing stress to computer operators in their working environments are a mixed type of both the conventional stressors at work and sources of stress stemming from the human-computer interaction.

3.1.5 Conclusions, research questions and hypotheses

So, the effects of computer experience/knowledge on stress and performance measures, and the relation between attitudes towards computers (including anxiety) and stress and performance, have been studied by a very limited number of researchers. Their results were varied and sometimes contradictory. There is certainly a prospect for further research into this area - studies which not only investigate the relationships between stress and prior experience, and stress and performance in relation to attitude and other variables, but also directly examine the effects of concurrent computer operations on all those variables. This can be done by measuring stress before each computer operation (involving a number of specific computer tasks) and both stress *and* performance after each computer operation; and this is the orientation of the present study.

In particular, and in the light of the previously discussed relevant literature, some of the main issues/questions emerged are the following:

- 1) Does a computer session change levels of stress? Is computer operation / use per se stressful? (e.g. Hudiburg, 1989, 1990; Kumashiro et al, 1989).
- 2) What is the effect of prior experience on computer stress and computer performance? (e.g. Dolan and Tziner, 1988).
In considering computer stress: a) Does prior experience affect change of stress from before to after a computing session? And b) Does prior experience affect absolute levels of stress?
- 3) How do computer attitudes (including computer anxiety, computer confidence, and computer liking) relate to computer stress and computer performance? (e.g. Hudiburg, 1989, 1990; Kumashiro et al, 1989).
- 4) Does information on attitude variables predict any of the variance of computer stress and performance?

The purpose of this study was to explore these questions in university students. More specifically, and in considering these issues, while according to Kumashiro et al's (1989) findings it is difficult to conclude that stress is increased by the interaction with the computer itself, according to Hudiburg's (1989, 1990) results the greater the number of hours

worked on the computer, the more likely the stress of the operator/user to be greater. In addition, while Hudiburg (1989, 1990) suggested that people with more computer experience tend to experience more computer-related stress, Dolan and Tziner (1988) argued that subjects without previous computer experience reported significantly higher experienced stress (with regard to aspects such as task difficulty, work autonomy, health and safety, and career path).

Thus, there are two possible hypotheses about the effects of a computer terminal session on stress:

- 1a. The conventional view (computers and computing seen as stressors), that the actual interaction with the computer, particularly with novel tasks, will be stress inducing. So, scores of stress are hypothesised to be higher after a terminal session than before the session.
- 1b. Alternate hypothesis: Since, anticipation of difficulties may lead to anxiety and stress, then here, anticipation of difficulty with computing is hypothesised to lead subjects to higher stress scores before the terminal session than after the session (where subjects may have, in the main, managed to accomplish the set tasks).

Other main hypotheses to be tested in this study were:

- 2a. those subjects with greater initial (prior) computer experience were hypothesised to show lower changes of stress from before to after computer interaction, as well as feel less stress before and after computer interaction, than those subjects who have relatively less experience. This hypothesis was formed because it was thought that interaction with computers would not only play an important role in affecting computer stress but also show the more experienced users to adapt easier in a relatively new computer situation.
- 2b. Those subjects with greater initial computer experience were hypothesised to perform better and experience less subjective difficulty on various computer tasks than those subjects with relatively less experience.
- 3a. Subjects with more favourable attitudes (and less anxiety) towards computers will experience lower levels of computer-related stress before and after each computer interaction and lower levels of stress changes between before and after each computer session.
- 3b. Subjects with more favourable attitudes (and less anxiety) towards computers will achieve higher levels of computer performance and will experience less subjective difficulty in completing a number of computer tasks.

3.2 Method

3.2.1 Subjects

The subjects were Undergraduates at the University of Durham and taking the required psychology practical sessions which have a computing component. This included introductory and advanced information and practice on the respective University Computer Operating System [MTS (Michigan Terminal System) in academic years 90-91 and 91-92, and UNIX in academic year 92-93]. It also contained basic and further (advanced) information and practice on a Screen Editor (CURLEW) and an electronic mail utility (EMU).

None of the subjects had studied Psychology previously at University, and most were in their first year of study.

The subjects were the first year psychology practical class of Durham University for three subsequent academic years, consisting of:

- i. Academic year 1990-91 - 99 individuals, 44 males and 55 females;
- ii. Academic year 1991-92 - 106 individuals, 47 males and 59 females;
- iii. Academic year 1992-93 - 119 individuals, 52 males, 58 females, and 6 unknown (missing data).

In total, the number of subjects participating in these studies was 324 (143 males, 172 females, and 6 unknown).

3.2.2 Materials and Measures

The most widely accepted way of defining stress states is with introspective verbal reports. The "inventory premise" (Spielberger, 1972) assumes

"..that people are willing, and able, to correctly describe their own feelings and behaviour".

In other words, stress can be considered as consciously experienced, and people can provide verbal evidence of their feelings. These assumptions provide the basis for self-report measures of stress (as well as anxiety).

The present study was based on self-report measures of computer stress and performance. These self-report measures were verbal surrogates for behavioural and physiological indicators of stress and performance. The measures were taken within the context of measurable performance on computer-based tasks.

Stress was assessed by using the SACL (Stress and Arousal Checklist, Cox and Mackay, 1978, 1985) (see Appendix 4). This has been used in various studies. In the present study, SACL was administered before and after each subject's interaction with the computer on several

occasions. In general, this interaction involved carrying out specific computer tasks that had been introduced previously in the practical class in the form of a lecture (more details will be provided below).

Each individual's (self-rated) performance and subjective difficulty at the computer were assessed by ratings of a series of tasks derived from Psychology Department Computing Practicals. The task lists were completed after each terminal session (see appendix 5 for task lists). Performance on the computing tasks was assessed through these ratings by considering: i) the number of task-list items each subject completed successfully, and ii) the total number of task-list items listed for each terminal session.

Difficulty on the computing tasks was assessed through the same ratings by considering: i) the number of task-list items each subject completed successfully, ii) the total number of task-list items listed for each terminal session, and iii) the amount of subjective difficulty each subject had in trying to complete the items of each list of tasks.

In addition, a brief post session questionnaire or checklist (namely, subjective ratings) was devised that included a list of items / ratings of responses to each of the computer sessions, emphasising issues of anger, frustration, stress, helplessness and perceived control (see Appendix 6).

Task lists and subjective ratings were both administered after each subject's interaction with the computer (details will follow).

3.2.2.1. Stress and Arousal Check List (SACL)

In discussing stress and arousal, the suggestion that the two states are independent is supported by work from a number of studies which found independent factors representing stress and arousal (e.g. King et al, 1983, 1987; Cox et al, 1977; Mackay et al, 1978, 1985, etc.).

Cox and his colleagues developed an adjective check list which produced two factors, namely 'stress' and 'arousal' (Mackay et al, 1978). Cox's Stress/Arousal Adjective Check List (SACL) was initially based on the responses of a sample of British university students; and further studies by Cox (Cox et al, 1977), which show within-subject differences due to exposure to "stressors", supported the validity of the two factors (stress and arousal). Furthermore, many researchers have found SACL of value in describing their stress data in an economic way (see Appendix 4). Also, SACL's further use in research was recommended by King and his colleagues (King et al, 1983).

The 30-adjective version of Cox and Mackay's SACL was used in this study (see Appendix 4). This version of the instrument provides for scores on two subscales: Stress (at this moment), and Arousal (at this moment). SACL takes less than five minutes to administer and complete.

According to King et al (1983), the scale is highly acceptable for repeated testing, as required in the present study.

On the 'stress' subscale of the Cox's Checklist, scores can range from 0 to 18, with higher scores indicating more stress experienced "now" by the subject. On the 'arousal' subscale, scores can range from 0 to 12, with higher scores indicating more arousal experienced "now" by the subject.

[For details on SACL, as well as justification and reasons why the SACL was chosen from the many mood measures which exist, see Technical Appendix 2].

3.2.2.2 Computer tasks, difficulty and performance

Lists of computer tasks were constructed, a different one (to be completed) for each computer practical session, showing the different parts of the respective week's practical (see 'Procedure' section for general context). These were Likert-type measures, each consisting of a variable number of items, depending on the range of the contents of the particular computer practical they referred to. The number of items included varied from 4 to 9 and the content of them was derived from the lecturer's handouts for each of the practicals. (See Appendix 5 for task lists).

Items on the computer tasks 'scale' derived from the first week computer practicals, comprise such statements as "Sign on, change password, sign off", and "Exercises on Curlew Tutorial Card". Items based on the practical of the second week contain such statements as "Read all your incoming messages" and "Compose and send a message to another member of the class". Statements on the 'scale' from the third week's practical include: "Get a printout of one of your messages" and "Check the registered name of someone in the class". Finally, the 'scale' based on fourth week's practical comprises such statements as "Use block mode to move, delete, and insert text" and "Use and practice with different system commands".

Items on the tasks' list were listed in the order in which they were to be carried out. In response to each statement, subjects indicated which one of a set of five ordered responses (ranging from 'no difficulty' to 'very difficult') most closely represented the extent to which they found each of the computer tasks difficult. As soon as the subjects had finished their computer session, they were asked to go through the list of tasks and a) for each task to circle the task number on the left if they completed it; b) for each task they tried (whether they completed it or not) they were asked to indicate how difficult they found it, by circling a number on the scale on the right ranging from 1 (no difficulty) to 5 (very difficult). The full set of the five scale descriptions were: 1 if they had no difficulty at all, 2 if they had only slight difficulty, 3 if they had a moderate amount of difficulty, 4 if they had fair amount of

difficulty, 5 if they had a great deal of difficulty. c) Finally, subjects were asked that for any tasks they did not try, to indicate why, e.g. "run out of time"; "unsure how to do it", etc (see Appendix 5).

Thus, according to (b) above, item responses on the right were coded so that a higher score corresponds to a higher degree of self-reported difficulty; also, according to (a) above, a higher score on the task numbers on the left corresponds to a higher degree of self-rated performance. By summing the items ratings on each scale, two scores may be obtained for each student. Scores on the tasks scales for self-reported difficulty may range from 0 to 45, depending on the amount of perceived difficulty, number of tasks listed, and number of tasks completed. Scores on the tasks scales for self-rated performance may range from 0 to 9, depending on the number of tasks listed and the number of tasks successfully completed.

In conclusion, the computer task measure assessed a) performance, by indicating its level (i.e. how many tasks were completed), and b) subjective difficulty, by indicating how difficult subjects found the respective computer tasks. The lists took one to five minutes to administer and complete.

3.2.2.3 Subjective (stress) ratings

In addition to the SACL, which emphasises 'here and now' stress, it was decided to collect some data immediately post-task, relevant to perceived stress, and with the intention of tapping issues of helplessness, control, and in addition the possibility of frustration and anger or aggression.

Therefore, a non - standardised questionnaire (set of items) with self-rating scales was constructed and administered (see Appendix 6).

There were eight main items, which present statements of various feelings and comments about each of the computer sessions. In particular, feelings and comments included amount of difficulty, usefulness, control, amount of help needed, stress, frustration, and anger. It was thought and concluded from the literature (e.g. Frese, 1986, 1987; Frese et al, 1987; Seligman, 1975), that the feelings of control, frustration, helplessness, and anger are not only highly relevant to the stress concept but also very much related to computer use. The statements about amount of help needed, amount of difficulty found, and usefulness of computers refer directly to computer use, and provide, in a simple and straightforward way, some important information about students' reactions to the preceding computer session.

These Likert-type scales also had to be as short as possible, because the intention was that subjects would not spend too much time on them; therefore it was decided that only a few items

were included and four-point scales were used in order to force a response of agreement or disagreement.

The scale contains positively and negatively worded statements. Positively worded items comprise such statements as "The session was useful to me" and "I felt in control of the situation". Negatively worded items include "The session was difficult", "I needed help", "I felt stressed", "I felt frustrated", etc. Overall, out of eight, five of the items are content reversed. These statements are also listed in random order with no category designation given. In response to all statements, subjects indicate which one of a set of four ordered responses (ranging from 'strongly agree' through 'agree' and 'disagree' to 'strongly disagree') most closely represents to which extent they agree or disagree with the feelings/comments listed. In particular, subjects were asked to fill in the ratings after the computer terminal session, and circle the appropriate number to the right of the statement in each case.

The responses were recorded and 'scored' on the basis of the numbers indicated. Responses for the positively worded items were recorded so that strongly agree = 1, agree = 2, disagree = 3, and strongly disagree = 4. Responses for the negatively worded items were recorded oppositely, i.e. strongly agree = 4, agree = 3, disagree = 2, and strongly disagree = 1.

Item responses are coded so that a higher score corresponds to a higher degree of stress, anger, frustration, difficulty and amount of help needed, and a lower degree of control and perceived usefulness of the session. By summing the items ratings, with scores for the negative items reversed, one single score can be obtained for each student and for each computer session. Total scores may range from 6 to 24, and in general a higher score corresponds to more negative feelings towards the respective computer session.

In addition, two more questions were asked and included in the ratings, providing 'yes' or 'no' alternative responses, to give indicators of subjects' performance and motivation. However, data derived from these two questions were not used or analysed. In particular, the questions were: 'Did you complete the session?', and 'Will you do some more computing (other than messaging) in your own time before the next session?'

Also, subjects were asked to name the computer program(s) they used during the respective computer session, and some space for additional comments on any issue was provided on the questionnaire sheet.

Finally, subjects were asked to provide some identification to allow for cross-reference to the other measures used, and were assured that all information they provided would be treated as confidential.

The 'subjective ratings' measure took less than three minutes to administer and complete.

3.2.3 Procedure

Three 3-hour Practical sessions were held each week (on Thursday, Monday, and Tuesday) at the beginning of each of the three academic years of data collection, and students/subjects were required to regularly attend one of them. The computing practicals were held for four weeks in academic year 90-91, for three weeks in academic year 91-92, and for four weeks again in academic year 92-93.

Within the academic year 90-91, the first week's practical was an introduction to the use of computer terminals, some general information about the University - MTS Computer Operating System, and an introduction to the CURLEW Screen Editor as well as exercises to practise with the editor. The second week's practical included an introduction and practice with electronic mail (i.e. EMU - Electronic Mail Utility). The third week's comprised further information on MTS and practice with MTS commands and electronic mail, introduction to Curlew Block Mode and printing. Finally, the last week involved further information on MTS and more practice with MTS commands, advanced Curlew screen editor (including block mode), advanced electronic mail, printing and paging commands and printing facilities.

Similarly, in the academic year 91-92, the first week's practical was again an introduction to MTS and CURLEW. While the second practical included information and practice on EMU, the third one was about advanced MTS (further commands), Curlew 'Block' Mode, and printing.

At the beginning of the academic year 1992-93, the Durham University computer operating system changed from MTS to UNIX. The first week of practicals contained an introduction to UNIX, and to the CURLEW screen editor. The second week involved information on and practice with EMU within UNIX. The third practical contained further information about UNIX, more practice with UNIX commands as well as electronic mail, introduction to Curlew block mode and printing. The fourth week involved information and exercises on UNIX commands, advanced CURLEW screen editor (including block mode), advanced use of EMU, and printing commands and facilities.

Subjects were firstly taught in a Psychology Department lecture room about mainframe computing and computer facilities in the University in general, and in the Psychology department in particular. Afterwards each set of students (approximately the one third of the class) was further divided into two sub-groups. The first sub-group remained in the lecture room while the second moved to the Psychology Department computer room for actual computer operation - practice and application of what they had been taught during the

preceding lecture. After finishing computing, the second group returned to the lecture room and then the first group moved to the computer room for their terminal session.

Subjects were administered one of the four versions of Cox's Mood Checklist (Cox and MacKay, 1978, 1985) immediately BEFORE they started any computer interaction, together with an instruction sheet to remind them briefly about the study being conducted (they already knew about the survey from the previously administered instruction sheet on the two attitude scales).

This sheet informed students that we were looking at possible changes of mood caused by sessions at the computer in relation to difficulty of and performance in specific computer tasks [the wording of the instructions was an adaptation of the wording recommended by Cox et al, (1978, 1985); for instruction sheet see Appendix 7].

Subjects were asked to fill in a set of four 'questionnaires' every time they had a session with the computer (i.e. once a week). Each of these sets consisted of the following: a) A Cox's Mood Checklist (SACL) about their feelings 'at this moment'; this should be filled in immediately before each computer session. b) A second SACL (but having its items listed in a different random order now) about their feelings 'at this moment'; this should be filled in immediately after each computer session. c) A list of computer tasks for each session (tasks subjective difficulty and performance measure) to be filled in after each computer session. d) A list of (subjective stress) ratings about subjects' general immediate reactions to each session's computing, to be filled in after each computer session.

So, subjects were asked to fill in one Mood Checklist before each computer session and three measures after, in the following order: the second Mood Checklist, the 'tasks' measure, and the 'ratings' measure. For the academic year 90-91 only, the 'ratings' measure was not used.

Subjects were also advised that this routine should be followed exactly for each of their computing practicals (i.e. four times within four weeks for academic years 90-91 and 92-93, and three times within three weeks for academic year 91-92).

Furthermore, subjects were advised to follow the instructions printed on each particular measure, to read each of the items carefully and try to respond as quickly and accurately as they could, remembering that there were no right or wrong answers and that their first reactions are usually the most reliable; therefore, they were advised not to spend too long considering each item. Finally, subjects were asked to make sure that they had answered every item required on each 'questionnaire'.

In addition, a brief introduction was given orally, explaining that the measures or 'questionnaires' formed another part of the PhD research, outlining the nature of the investigation and what they had to do.

The subjects were then given time to complete the questionnaires, after which they were collected individually, and briefly checked to ensure that there was no missing data. In this event, the subject was asked to complete the missed item.

In all cases the researcher remained present during distribution, completion and return of the 'questionnaires', answering questions and helping subjects, when required, to appropriately complete the measures.

3.3 Results

Note, that the consideration of the 'arousal' variable only emerges from the measure used for the assessment of 'stress', i.e. Cox's SACL. Thus, information on 'arousal' comes in excess of that needed to test the hypotheses of this study, which mainly deals with computer stress in relation to computer experience, computer performance and attitudes. These "excess" results are not important to this study, and therefore will not be reported or discussed.

3.3.1 Changes in SACL from BEFORE to AFTER a computer session

(1. Does a computer session change levels of stress? Is computer operation / use per se stressful?)

The means and standard deviations for all stress scores are presented in Table 3.1 below. The data are for all three academic years collapsed together. On the 'stress' subscale of the Cox's Checklist, scores can range from 0 to 18, with higher scores indicating more stress experienced "now" by the subject. The means indicated that students as a whole, in both occasions (before and after computer interaction) and for each of the four weeks, experienced average to low amount of stress.

Table 3.1. Overall Summary of Means of STRESS scores, before and after computer session, over all three years collapsed together, and for all subjects as 'paired samples' (Note that these data are based on the same subjects before and after computer interaction)

Week	Topic of practical session	n	before	after
1	Introduction to Computer Operating System and Screen Editor)	248	4.89	5.87*
2	Screen Editor and Introduction to Electronic Mail	268	5.01	5.14
3	Electronic Mail, Screen Editor Block Mode, and Printing	277	5.64	5.59
4	Further Computer Commands; Advanced MTS/UNIX, Screen Editor, and Electronic Mail	177	4.83	4.79

*p < 0.05

The data were explored with repeated measures two-tailed tests. These were performed on stress for each week separately, to assess whether the scores on Test 2 (after computer interaction) were significantly different than on Test 1 (before computer interaction).

It is clear that the computing session produces little or no change in the mean stress score, with the exception of Week 1. Here, there is a significant increase in the mean ($p < 0.05$). This supports the hypothesis that the computer session is stress inducing (a) rather than the alternate hypothesis that it would be stress reducing (b). However, the increase of computer stress is only transient.

3.3.2 Effects of prior computing experience on Stress

(2. a) What is the effect of prior experience on changes of computer stress from before to after sessions? b) What is the effect of prior experience on absolute levels of stress before and after a session?)

2a) So, is there any effect of prior experience on stress, and its changes from Test 1 to Test 2? In order to answer this question, responses to Question 1 of the DCAS were considered.

As a reminder, question 1 on the DCAS requires subjects to indicate what sort of things they use computers for, and to rank order eight alternative computer activities. On the basis of the responses to this, the eight alternative uses and users were categorised into four groups:

1: No Experience - Naive Users or Novices

2: Only Computer Games Players

3: Medium Users: Communications, Word Processing, Instructional / Educational Programs

4: High Users: Program Development, Statistical Analysis, Control, and Other

The means for the stress subscale scores (collapsed over all three years) for all four groups of computer experience, before and after each computer session, and for each week of the computing practicals separately, are presented in Figure 3.1.

Fig 3.1. Stress scores (SACL) before and after sessions for weeks 1 to 4

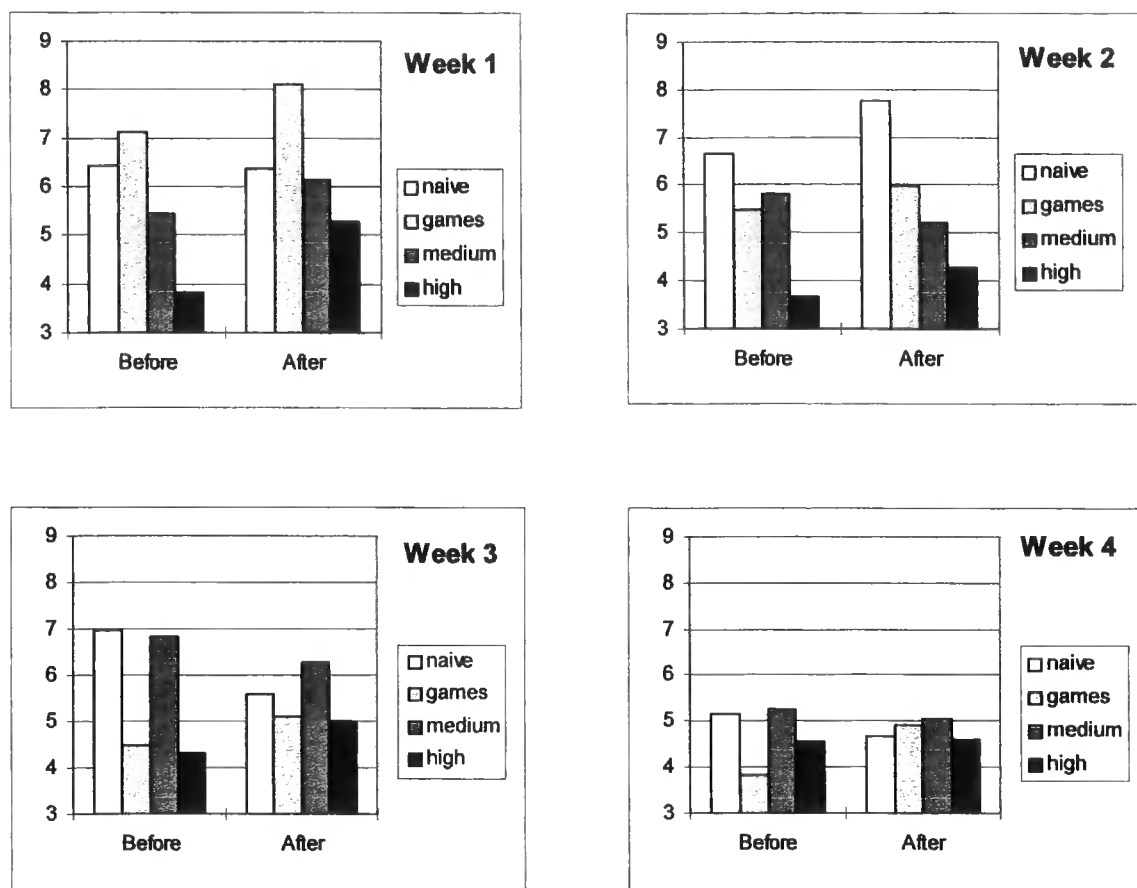


Figure 3.1 suggests that high experience users have lowest stress scores on all first three weeks both before and after each computer session. Figure 3.1 also suggests, that in the case of ‘high’ users, although the initial stress scores are relatively low, the means of the stress scores on the first three weeks (especially on Week 1) increase from before to after computer interaction.

The data were collapsed over four weeks for each of the four groups of computer experience. Then, comparisons of pre-session to post-session stress were made by performing repeated measures two-tailed t-tests for each group separately. It was found that post-session stress scores were significantly higher than pre-session stress scores only for group 4 (high users) (see Table 3.2 below).

This result was inspected in case it is due to a possible ‘ceiling effect’ - such that pre-session stress scores of groups 1, 2, and 3 are near their maximum. However, as pre-session stress scores are not close to the top of their possible range (i.e. close to 18) (see Table 3.2 and Figure 3.1), this does not appear to be the case.

Table 3.2. Means (and standard deviations in brackets) for the four experience groups collapsed across weeks.

Group	N	Before	After
1 Naïve	31	7.17 (4.86)	7.19 (4.79)
2 Games	20	5.39 (3.17)	6.38 (3.30)
3 Medium	126	5.82 (3.45)	5.84 (3.72)
4 High	123	4.13 (3.50)	4.87 (3.85)**

P=0.004

Although the high users' initial stress score was relatively low, the increase of this score, over all four weeks, was highly significant ($p < .005$) (see Table 3.2 and Figure 3.1).

In addition, the data for High Users only were further explored with repeated measures two-tailed tests. These were performed on stress before computer interaction and stress after computer interaction and for each of the four weeks separately. It was found that the increase of the stress score on Week 1 was highly significant ($p < 0.007$), and the increase on Week 2 was marginally significant ($p < 0.07$). However, the slight differences of the scores on Weeks 3 and 4 were found not to be significant (see Table 3.3 below).

Table 3.3. Means of stress scores, for high computer experience users, before and after computer sessions, and for each week separately.

Week	Topic of practical session	n	before	after
1	Introduction to Computer Operating System and Screen Editor)	96	3.83	5.28**
2	Screen Editor and Introduction to Electronic Mail	113	3.66	4.29ms
3	Electronic Mail, Screen Editor Block Mode, and Printing	113	4.31	5.00
4	Further Computer Commands; Advanced MTS/UNIX, Screen Editor, and Electronic Mail	82	4.57	4.59

** $p < 0.007$

ms (marginally significant) $p < 0.07$

n numbers of pairs

It is clear from Table 3.3 (and Figure 3.1) that in the case of the High Users, the computing session produces a highly significant change (increase) in the mean stress score **only** for the first week of the practicals.

2b) In order to assess the effect of prior computer experience on subjects' absolute levels of stress before and after a session, two one-way analyses of variance (ANOVA) were conducted, for the four experience groups, on their stress scores before and after computer sessions (each collapsed across four weeks) respectively (see Table 3.2).

The first ANOVA compared the four groups of prior experience on the 'stress before computer interaction' variable. The results of the ANOVA procedure, using 'stress before' scores as the dependent variable, indicated that the main effects for computer experience were statistically significant [$F(3,300)=7.99, p<.001$].

A Bonferroni test indicated that scores for group 4 (high users) were significantly different (lower) than those for groups 3 and 1 (medium and naïve users respectively). No significant difference was found with the 'game players', maybe one of the reasons being the small size of the 'games' group.

The second ANOVA compared the four groups of prior experience on the 'stress after computer interaction' variable. The results of the ANOVA procedure, using 'stress after' scores as the dependent variable, indicated that the main effects for computer experience were statistically significant [$F(3,300)=3.68, p<.02$].

A Bonferroni test indicated that scores for group 4 (high users) were significantly different (lower) than those for group 1 only (naïve users). No significant difference in 'stress after' was found either with the games players or the 'medium' users, indicating that in general the preceding computer tasks were related to similar amounts of stress after sessions for the 'medium' and 'high' users. This is possibly because the level of the computing skills required to complete these tasks was not only below the 'high' users expected computing abilities but also below the 'medium' users computing skills.

3.3.3 Subjective ratings

The frequencies of the four responses for each of the four weeks of the practicals, for each of the eight items of the ratings list, and for all students together, are shown in Table 3.4.

Table 3.4. Frequencies of responses to subjective ratings

scale number: 1=strongly agree, 2=agree, 3=disagree, 4=strongly disagree

	Week 1: n=176					Week 2: n=172			
<i>Item</i>	1	2	3	4		1	2	3	4
1 The session was difficult	7	58	81	30		11	39	77	45
2 The session was useful to me	28	125	20	3		26	120	22	4
3 I felt in control of the situation	19	75	62	20		28	89	41	14
4 I needed help	33	103	31	9		23	87	44	18
5 I preferred to work it out for myself rather than ask for help	10	61	87	18		15	63	77	17
6 I felt stressed	12	59	71	34		9	37	78	48
7 I felt frustrated	17	48	74	37		11	40	73	48
8 I felt angry at the computer	10	22	83	61		6	16	83	67

	Week 3: n=177					Week 4 n=90			
<i>Item</i>	1	2	3	4		1	2	3	4
1 The session was difficult	12	54	81	29		7	27	41	15
2 The session was useful to me	32	117	16	12		16	59	9	6
3 I felt in control of the situation	24	82	54	17		16	40	19	13
4 I needed help	39	80	43	13		22	44	15	9
5 I preferred to work it out for myself rather than ask for help	14	59	79	24		7	25	48	9
6 I felt stressed	12	57	74	34		10	20	35	25
7 I felt frustrated	18	52	65	42		12	15	36	27
8 I felt angry at the computer	15	23	74	65		6	11	37	35

The percentages for responses of agreement falling into the first two scale numbers [strongly agree (1) and agree (2)], and for each week, are shown in Table 3.5. Scale items 2, 3, and 5 were reversed, so that low scores on all items indicate negativity to the session.

Table 3.5. Percentages for responses of agreement.

	Week			
	1	2	3	4
1 Session was difficult	37	29	38	38
2 Session was useful (Reverse)	13	15	16	17
3 Felt in control (Reverse)	47	32	40	36
4 Needed help	77	64	68	73
5 Preferred to work it out by self (Reverse)	60	55	59	64
6 Felt stressed	40	27	39	33
7 Felt frustrated	37	30	40	30
8 Felt angry at the computer	18	13	21	19

Although results from Table 3.1, and only for the first week of the practicals, indicate that there was a significant increase of stress levels from before to after computer interaction, as indexed by SACL, the majority of subjects believed that sessions were not difficult. The second week session in particular (mainly introducing the electronic mail) appeared to be reported as the easiest.

Furthermore, similar proportions of subjects appeared to feel stressed, frustrated and out of control. Although these proportions are always below 50%, this result seems to contradict previous findings derived from the use of Cox's SACL. According to SACL, not only the overall experienced stress appears to be low, but also the computing session produces only a transient (i.e. for the first week only) significant stress increase.

The subjective ratings (CPTOT) variable

In addition to the previous frequencies and percentages, the response to each question and for each subject was recorded each week. Then, scores were reversed for items 1, 4, 6, 7, and 8, so that the higher the score the more stressed (frustrated, angry, etc) the subject was reported to be. In addition, for each subject the mean rating for each of the questions was calculated. Subsequently, the data were entered the SPSS, and factor analysis was performed. By conducting a principal factor analysis with Varimax rotation, two factors emerged. When item 5 was dropped (for theoretical reasons – its meaning is hard to locate), a single factor solution was obtained: all items but item 2 having a high loading on this factor. This item 2 was also dropped to produce the 'subjective ratings' variable, encoded as CPTOT. The coefficient alpha of CPTOT (based on these 6 items) was found to be 0.904.

Subsequently, a 'subjective ratings' (CPTOT) total score was calculated, for each subject and for each week's session separately, by summing the individual ratings of items ratings (with scores for the negative items reversed). These total scores could range from 6 to 24, and a higher score corresponded to higher stress and more negative feelings towards the respective computer session. Thus, four 'subjective ratings' total scores were calculated for each subject, one for each week of the computer practicals. Also, a mean was derived for each subject as the average of the four weeks' sessions.

The means and standard deviations for all subjective ratings scores are presented in Table 3.6 below. The data are for two academic years collapsed together. Scores can range from 6 to 24, with higher scores indicating more stress and stress related feelings experienced towards computing sessions. The means indicated that students as a whole, and for each of the four weeks, experienced average to low amount of stress and stress related feelings.

Table 3.6. Overall Summary of Means and Standard Deviations of subjective ratings scores, as reported after computer session, over two years collapsed together, and for all subjects.

Week	Topic of practical session	n	Mean	StD
1	Introduction to Computer Operating System and Screen Editor)	176	14.05	3.93
2	Screen Editor and Introduction to Electronic Mail	172	12.90	4.18
3	Electronic Mail, Screen Editor Block Mode, and Printing	176	13.91	4.03
4	Further Computer Commands; Advanced MTS/UNIX, Screen Editor, and Electronic Mail	90	13.64	4.73

Note here that for the subjective stress ratings only, there are many missing cases because data were collected only for the two last academic years of data collection (91-92 and 92-93, N = 229).

In order to assess the effect of prior computer experience on subjective ratings (CPTOT), a one-way analysis of variance (ANOVA) was conducted, for the four experience groups, on their subjective ratings scores as reported after computer sessions (each collapsed across four weeks).

The ANOVA compared the four groups of prior experience on the CPTOT variable. The results of the ANOVA procedure, using CPTOT scores as the dependent variable, indicated that the main effects for computer experience were statistically significant [$F(3,199) = 4.50, p < .007$].

A Bonferroni test indicated that scores for group 4 (high users) were significantly different (lower) than those for groups 3 and 2 (medium users and games players respectively). No significant difference was found with the naïve users, possibly due to the small size of the 'naïve users' group.

3.3.4 Performance, (subjective) difficulty, and experience

Task ratings scoring procedure

Performance and (subjective) difficulty measures/variables, for each subject and for each computer session, were scored according to the computer tasks ratings which had been filled in, together with the second SACL and the 'subjective ratings', after each computer session (see also Method; Materials and Measures, and Procedure).

3.3.4.1 Measuring performance by using the task ratings

Because the number of tasks varied from week to week, a performance ratio was calculated as follows:

After having finished each of their computer sessions, subjects were instructed to go through the list of tasks, and for each task to circle the task number if they completed it. The number of tasks completed was summed and then divided by the total number of tasks set for that week to give a ratio. Thus, for a week with 8 tasks in the session, if the subject completed 7 tasks, a performance ratio of 0.875 was scored.

This ratio yielded a range from 0 to 1. The closer to 1 a performance score was, the higher and better the performance was considered to be for a subject within each computer session. Thus, four performance scores were calculated for each subject, one for each week of the computer practicals.

3.3.4.2 Measuring subjective difficulty by using the task ratings

The variable / measure of subjective difficulty was intended to give a concise indication of the amount of difficulty each subject experienced for each of the computer sessions.

Similarly to performance, subjective difficulty, for each subject and for each computer session, was calculated as follows:

After having finished each of their computer sessions, subjects were instructed to go through the list of tasks, and, for each task they completed, to indicate how difficult they found it by circling a number on the scale provided (next to each task/item) ranging from 1 (no difficulty) to 5 (very difficult).

These numbers (scores indicating amount of difficulty for each of the tasks) were summed and then divided by the total number of tasks completed for that week to give a ratio. This ratio was reversed by being subtracted from the number 6, so, similarly to the performance score, a higher score corresponded to a more positive interpretation. In this way, this was really now a measure of easiness as higher scores mean less difficulty.

Thus, for a week with 7 completed tasks in the session, if a subject's responses (indicating amount of difficulty from 1 to 5 for each item) were 1, 3, 2, 4, 3, 5, and 5, then his/her summed score would be 23 ($=1+3+2+4+3+5+5$). Then, a ratio of 3.28 can be obtained by dividing the sum 23 by the number of tasks, 7. If now the score of this ratio is reversed, by subtracting it from the number 6, then the score of 2.72 will be obtained ($2.72 = 6 - 3.28$).

Thus, the subjective difficulty score yielded a range from 1 to 5. The closer to 5 the subjective difficulty score was, the more positive it was, i.e. the less the subjective difficulty reported by a subject for each computer session. Thus, four subjective difficulty scores were calculated for each subject, one for each week of the computer practicals.

3.3.4.3. Effects of prior experience on performance and subjective difficulty

So, is there any effect of prior experience on performance and/or subjective difficulty?

The means for Performance and Subjective Difficulty 'scales', for each week and each experience group separately, are shown in Tables 3.8a and 3.8b. On the 'performance scale' scores can range from 0 to 1, with higher scores indicating better performance by the subject. On the 'subjective difficulty scale' scores can range from 1 to 5, with higher scores indicating less difficulty experienced by the subject. The topics for each of the four weeks were as follows:

Week	Topic of practical session
1	Introduction to Computer Operating System and Screen Editor)
2	Screen Editor and Introduction to Electronic Mail
3	Electronic Mail, Screen Editor Block Mode, and Printing
4	Further Computer Commands; Advanced MTS/UNIX, Screen Editor, and Electronic Mail

Table 3.7a. Means of Performance scores for each of the four groups of computer experience and each week separately

	Naïve Users		
Week	N	Mean	St D
1	15	.89	.17
2	27	.90	.19
3	22	.84	.27
4	16	.76	.27

	Games Players		
N	Mean	St D	
18	.85	.27	
18	.84	.21	
19	.80	.24	
11	.80	.29	

	Medium Users		
Week	N	Mean	St D
1	110	.91	.17
2	103	.92	.16
3	109	.82	.24
4	59	.85	.23

	High Users		
N	Mean	St D	
99	.89	.17	
106	.86	.18	
111	.85	.24	
81	.87	.19	

(Ratio of 1 – all items completed)

Table 3.7b. Means of Subjective Difficulty scores for each of the four groups of computer experience and each week separately

	Naïve Users		
Week	N	Mean	St D
1	15	3.49	1.28
2	27	4.12	0.62
3	22	3.98	0.92
4	16	3.40	1.51

	Games Players		
N	Mean	St D	
18	3.35	1.18	
18	3.55	1.22	
19	3.91	0.98	
11	2.97	1.19	

	Medium Users		
Week	N	Mean	St D
1	110	3.86	1.01
2	103	4.09	0.80
3	109	3.95	0.88
4	59	3.47	1.25

	High Users		
N	Mean	St D	
99	4.00	1.07	
106	4.42	0.67	
111	4.14	0.90	
81	3.86	1.28	

(5 = no difficulty, 1 = very difficult)

The means indicate that all students, and for each of the four weeks of the practicals, demonstrated a high level of performance and experienced a low amount of subjective difficulty.

a) Performance and prior experience

Results are shown in Table 3.7a. All groups seemed to perform similarly on each week's different computer tasks.

However, because a particular interest was shown in the effects of prior experience on performing each week's specific computer tasks, the data here were firstly analysed for each week separately.

ANOVAs were performed for each of the four weeks. The results indicated that there were no effects of prior computer experience on performance for any week.

As a further check, in order to increase precision, the data were collapsed across weeks. The mean performance scores, for all weeks collapsed together and for each group separately were: for naïve users **0.84**, for game players **0.82**, for medium users **0.87**, and for high users again **0.87**). A one-way ANOVA was then performed between the experience groups. There were still no differences on performance.

b) Subjective Difficulty and prior experience

As a reminder, in the case of the subjective difficulty, higher scores indicate less difficulty and a more positive result.

Results are shown in Table 3.7b. There is a slight suggestion here that different computer experience groups seem to experience different amounts of subjective difficulty.

Data were collapsed across weeks. In considering the mean subjective difficulty for all weeks collapsed together, and for each group separately, naïve users score **3.91**, game players **3.66**, medium users **3.94**, and high users **4.02**.

While it may be expected that the higher the computer experience of the user the less the subjective difficulty he/she should experience during actual computer interaction, the fact that game players appear to experience higher levels of subjective difficulty than naïve subjects may be explained by the contrast between the 'easy', 'fun' and pleasant computer application of games that 'game players' were used to and the computer tasks (more 'formal' computer use) that the 'game players' had to complete within the practicals.

A one-way ANOVA was performed between the experience groups. The results indicated that there was a significant effect of prior computer experience on subjective difficulty [$F(3,302) = 5.50, p < .001$]. A Bonferroni test, performed subsequently, indicated that scores for the 'high users' were significantly different (higher: indicating less subjective difficulty) than those for 'medium users' and 'game players' respectively – but not than those for the naïve users.

So, the ANOVA for subjective difficulty show that there is an effect of computer experience on subjects' experienced subjective difficulty. This impact, again, was mainly due to the effects of the 'high experience' computer users.

While performance appeared to be similarly high for all groups of experience, subjective difficulty seemed to be different. In particular, high experience subjects reported lower levels of subjective difficulty (i.e. had higher subjective difficulty scores) than 'medium' experience subjects and game players.

Medium experience subjects reported lower levels of subjective difficulty than games players, and naive subjects reported lower levels of subjective difficulty than games players, although these results were not statistically significant.

3.3.5 Attitudes, stress, and performance

(3. How do initial computer attitudes relate to subsequent computer stress and computer performance?)

In order to answer this question, correlations were conducted with the participation of the following variables:

The initial attitudes were the scores obtained at the start of the year from CAS and DCAS, as described in chapter 2. In the case of CAS, the three subscales of Anxiety (CANX1), Confidence (CCON1), and Liking (CLIK1) were used.

Three indices of stress, one indicator of performance, and an index of subjective difficulty were used. The indices of stress concentrated on stress experienced before and after computer sessions, as measured by Cox's SACL, and labelled as STRBEF and STRAFT respectively; stress (including frustration, control, and anger) after computer sessions was also used as measured by the subjective ratings, and labelled as CPTOT. The indicator of performance (PERF) was based on the number of tasks completed divided by the total number of tasks set for each week. The index of subjective difficulty was based on the sum of scores indicating amount of difficulty for each of the tasks divided by the total number of tasks completed for each week. This ratio was labelled as 'subjective difficulty' (SUBJ). In particular:

i) Stress Before computer interaction (STRBEF)

The scores for stress BEFORE computer interaction were considered, as measured by Cox et al's Stress and Arousal Mood Checklist (SACL; 1978, 1985). One score was provided for each subject based on the average score obtained over up to four sessions. Scores could range from 0 (minimum stress) to 18 (maximum stress).

ii) Stress After computer interaction (STRAFT)

The scores for stress AFTER computer interaction were considered, as measured by Cox et al's Stress and Arousal Mood Checklist (SACL; 1978, 1985). One score was provided for each subject based on the average score obtained over up to four sessions. Scores could range from 0 (minimum stress) to 18 (maximum stress).

iii) Subjective Ratings (CPTOT)

The subjective ratings were a set of six items, which presented post session feelings and comments about each of the computer sessions.

Here, the total scores were considered for each subject and after each of the computer sessions. These scores (as seen before) were simply calculated by summing 6 of the individual items / ratings, with scores for the negative items reversed; one score was provided for each subject and for each week's computer session. Scores could range from 6 (minimum stress and negative feelings) to 24 (maximum stress and negative feelings).

Note that for the 'stress ratings', data were collected only for the last two academic years of data collection (91-92 and 92-93). The score used was based on the mean of the sessions.

iv) Performance (PERF) and Arcsine Performance (ARCSPERF)

As previously described, for each subject and after each computer session (i.e. each week of practicals) the number of tasks completed was summed and then divided by the total number of tasks set for that week to give a ratio, the performance score. Scores could range from 0 (minimum performance) to 1 (maximum performance). There were up to four performance scores for each subject, one for each of the computing practicals, and the value used was the mean of these.

Because analysis of residuals indicated that performance needed transformation (for example, the distribution of performance scores was found to be skewed and produced problems for regression analysis), an ARCSINE transform was used to stabilise the variance (and improve the distribution).

Although ANOVA is comparatively robust to deviations from normality (Keppel, 1973), regression analysis is not. At this point, it was necessary to do transformations for the regression data.

v) Subjective Difficulty (SUBJ) and Log transformed Subjective Difficulty (SUBJLOG)

In the case of subjective difficulty, as self-rated after computer interaction, scores were calculated for each subject and after each computer session (i.e. each week of practicals) as

previously described. Scores could range from 1 (maximum difficulty) to 5 (minimum difficulty). There were up to four difficulty scores for each subject, one for each of the computing practicals, and the value used was the mean of these.

Similarly to performance, and in order to stabilise the variance, the variable SUBJ was firstly reflected and then a log transform was performed (hence the SUBJLOG). (Note that because of the transform, the sign went the opposite direction).

Table 3.8 summarises the descriptive statistics and characteristics for all attitudes, stress, performance and subjective difficulty variables scores involved in the correlations of this chapter. Stress, performance and difficulty values were based on the average score (mean) obtained over up to four weeks of computer sessions collapsed together. The values were obtained from the sample of 342 participating students.

Table 3.8. Descriptive statistics and characteristics for chapter three variables.

Test	Variable	Range	Mean	St Dev	Min	Max	N
CAS	CANX1	10 to 70	46.69	12.63	15.0 0	70.00	320
	CCON1	10 to 70	45.13	11.35	11.0 0	70.00	320
	CLIK1	10 to 70	42.46	11.05	14.0 0	69.00	320
DCAS	DCAS1	20 to 100	64.16	12.29	23.0 0	97.00	320
Cox	STRBEF	0 to 18	5.26	3.82	.00	17.00	329
	STRAFT	0 to 18	5.61	3.97	.00	16.00	328
Subjective Ratings	CPTOT	6 to 24	13.64	3.33	6.33	21.33	226
(Log) Subjective Difficulty ¹	SUBJLOG		.62	.34	-.03	1.61	336
(Arcsine) Performance ²	ARCSPERF		1.14	.32	.29	1.57	336

¹ Subjective Difficulty range of numerical scores is from 1 to 5. Log transform used

² Performance range of numerical scores is from 0 to 1. Arcsine transform used.

On the basis of the variables above, a correlation matrix was constructed, as shown in table 3.9. The direction of the scores is as follows.

ATTITUDES: CAS & DCAS

CANX1 (CAS subscale - Computer Anxiety on Test 1): the higher the score the LESS the computer anxiety and the better the computer attitude

CCON1 (CAS subscale - Computer Confidence on Test 1): the higher the score the more the computer confidence and the better the computer attitude

CLIK1 (CAS subscale - Computer Liking on Test 1): the higher the score the more the computer liking and the better the computer attitude

DCAS1 (Durham Computer Attitude Scale): the higher the score the better the computer attitude (and the more the computer liking)

COX

STRBEF (Stress before): the higher the score the higher the levels of stress. It is the SACL score before computer interaction.

STRAFT (Stress after): the higher the score the higher the levels of stress. It is the SACL score after computer interaction.

CPTOT (Subjective stress ratings): the higher the score the higher the levels of stress, anger, frustration, helplessness, etc after computer session

PERF Performance on the computer tasks set; the higher the score the better the performance (ARCSPERF is shown)

SUBJ: Subjective difficulty of the computer tasks: the higher the score the LESS the subjective difficulty as self-rated after computer interaction (SUBLOG reverses this sign).

Table 3.9. Correlation Matrix: Pearson's r Correlation Coefficients.

Correlations between initial attitudes, stress before, stress after, subjective ratings, performance and subjective difficulty variables

	2	3	4	5	CANX1	CCON1	CLIK1	DCAS1
1 STRBEF	.70**	.47**	.03	.37**	-.39**	-.37**	-.19**	-.33**
2 STRAFT		.61**	-.06	.39**	-.32**	-.32**	-.18**	-.29**
3 CPTOT			-.17*	.74**	-.50**	-.54**	-.37**	-.49**
4 ARCSPERF				-.18**	.13*	.14*	.12*	.18**
5 SUBJLOG					-.43**	-.46**	-.30**	-.41**
6 CANX1						.83**	.69**	.77**
7 CCON1							.73**	.79**
8 CLIK1								.79**
9 DCAS1								

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

i) Correlations between initial attitudes and three indices of stress

Firstly, there were fairly large, negative and significant ($p < 0.01$) correlations between two of the initial scores of CAS' subscales (computer anxiety – CANX1, and computer confidence – CCON1) and each of the scores on 'stress before' and 'stress after', as measured by SACL. These correlations suggest that the less anxious and the more confident the subjects were towards computers, the less the stress before and the less the stress after computer sessions they were likely to experience.

The correlations between the initial score of the 'computer liking' (CLIK1) CAS subscale and STRBEF and STRAFT were smaller than for confidence and anxiety but still significant.

These results were echoed in the DCAS data. The negative correlations between the initial score of the Durham Computer Attitude Scale (DCAS1) and the scores on 'stress before' and 'stress after' were significant. In particular, the better the subjects' attitudes towards computers, the less the experienced stress before and after computer sessions.

There were also large, negative and significant correlations between two of the three scores of the CAS' subscales (CANX1, and CCON1) and the score on subjective ratings (CPTOT), as reported after computer interaction. And, similarly, there was a large and significant correlation between the score on DCAS1 and the score on CPTOT. The correlation between CLIK1 and CPTOT was smaller than for confidence and anxiety but still significant. These correlations indicate that the less the anxiety, the more the confidence and liking the subjects had and the better their general attitude towards computers, the less the stress, frustration, anger, helplessness, etc they were likely to report after computer sessions.

Generally, most of the correlations here are fairly large. Interestingly, computer confidence, computer anxiety and DCAS, both in relation to subjective ratings, give the largest correlations; whereas computer liking in relation to 'stress before' and 'stress after' gives the smallest. Now, it may be that although experience seemed to be a good predictor of stress, as previously discussed, stress, anger, frustration, etc, as measured by the subjective ratings, and to a lesser extent 'stress before' and 'stress after', as measured by SACL, may also be a function of attitudes towards computers (as measured by CAS and DCAS).

In view of the previous correlations findings, it would appear that there is a close relationship between attitudes and stress. Although correlations should not be interpreted as cause-and-effect relationships, an interpretation could be that more positive and anxiety-free attitudes towards computers produce lower levels of stress, measured immediately before and after a session with the computer. It may also be reasonable to suggest that the experience of lower computer stress may, in turn, enhance and increase the positivity of computer attitudes.

ii) Correlations between initial attitudes, and performance.

There were three significant, positive but small correlations between initial computer attitudes (CAS: computer anxiety, computer confidence, and computer liking), and computer performance (ARCS PERF); and there was a slightly larger significant correlation between initial computer attitude, as measured by DCAS, and computer performance. In particular, the less the subjects' computer anxiety, the more their confidence and liking and the more positive their general attitude towards computers, the more likely they were to perform better on various computer tasks.

In general, while correlations between initial computer attitudes and computer performance are small, they are significant. Interestingly DCAS1 gives the largest correlation. Now, it may be that this is just a function of computer experience; however it is to be noted that, although experience seemed to be a good predictor of attitudes and anxiety, no differences in performance were found between the experience groups on performance (see relevant sections before).

In view of the previous correlations findings, it would appear that there is a close relationship between attitudes and performance. Again, although correlations should not be interpreted as cause-and-effect relationships, it may be reasonable to assume that more positive and anxiety-free attitudes towards computers are likely to result in better actual computer performance. It may also be reasonable to suggest that the achievement of higher computer performance may, in turn, enhance and increase the positivity of computer attitudes.

iii) Correlations between initial attitudes and subjective difficulty

Firstly, there were three significant correlations between the initial scores of CAS's subscales (CANX1, CCON1, and CLIK1 respectively) and the scores on subjective difficulty (SUBJLOG). These correlations mean that the less anxiety, the more confidence, and the more liking the subjects had towards computers, the less the subjective difficulty they were likely to experience when completing various computer tasks.

These results were also echoed in the DCAS data. So, similarly, the correlation between DCAS1 and SUBJLOG was positive and significant. In particular, the better the subjects' general attitude towards computers, the less the difficulty experienced when dealing with particular computer tasks during actual computer operation.

Generally, the correlations here are between 0.30 and 0.46. Computer liking gives the smallest and confidence the largest.

Multiple Regression

(4. Does information on attitude variables predict any of the variance of computer stress and performance?)

In order to answer this question, multiple regression analysis was conducted to look at the contribution of the attitude variables to the outcome. For each of the regressions, the dependent variable was one of the following: performance (ARCSPERF), subjective difficulty (SUBJLOG), stress before computing sessions (STRBEF), stress after computing sessions (STRAFT), or the subjective ratings indicating stress, frustration, anger, etc, after computer sessions (CPTOT).

The independent variables for each of the regressions were either the CAS' attitude dimensions of (initial) computer anxiety (CANX1), confidence (CCON1) and liking (LIK1) or (initial) general computer attitude as measured by the DCAS (DCAS1).

All attitude variables showed significant correlations with all stress, performance and subjective difficulty variables. In particular, CANX1, CCON1 and DCAS1 in relation to subjective ratings gave especially large correlations. A particular interest was given to the variable of computer anxiety, as, stemming from the relevant literature, a fresh attempt was made to find out the extent to which computer anxiety could predict the dependent variables.

Before conducting multiple regressions, results of evaluation of assumptions led, where appropriate, to transformation of the variables to reduce skewness in their distributions, remove the outliers, and improve the normality, linearity and homoscedasticity of residuals. In particular outliers were removed as standard.

When the CAS's attitude dimensions were used as independent variables, stepwise regression procedure in SPSS.8 for Windows was used to investigate the relative contributions of the three attitude dimensions. When DCAS1 was the independent variable, 'Enter' regression procedure in SPSS.8 for Windows was used to assess to which extent DCAS1 was a predictor of each of the dependent variables. In all cases, multiple R's, R Squares, Adjusted R Squares, R Square differences, Beta weights, and significance levels were considered.

There was some concern that collinearity may affect the outcome, since the CAS sub-scales intercorrelate highly. However, 'tolerance levels', given by SPSS, indicated that the sub-scales are sufficiently separate. In addition SPSS.8 regression procedures protect from collinearity by automatically excluding from the regression equations all independent variables which are diagnosed or suspected to be collinear with others.

Table 3.10. Multiple regression & regressions of CAS and DCAS on stress and performance dependent variables.

Dependent Variable: STRBEF

Model	Predictors	R	R ²	Adj. R ²	ΔR^2	Beta	Sig.
1	CANX1	.392	.154	.151	.154	-.392	.000

Dependent Variable: STRBEF

Model	Predictors	R	R ²	Adj. R ²	ΔR^2	Beta	Sig.
1	DCAS1	.348	.121	.118	.121	-.348	.000

Dependent Variable: STRAFT

Model	Predictors	R	R ²	Adj. R ²	ΔR^2	Beta	Sig.
1	CCON1	.329	.108	.105	.108	-.329	.000

Dependent Variable: STRAFT

Model	Predictors	R	R ²	Adj. R ²	ΔR^2	Beta	Sig.
1	DCAS1	.306	.093	.090	.093	-.306	.000

Dependent Variable: CPTOT

Model	Predictors	R	R ²	Adj. R ²	ΔR^2	Beta	Sig.
1	CCON1	.555	.308	.305	.308	-.555	.000

Dependent Variable: CPTOT

Model	Predictors	R	R ²	Adj. R ²	ΔR^2	Beta	Sig.
1	DCAS1	.503	.253	.249	.253	-.503	.000

Dependent Variable: ARCSPERF

Model	Predictors	R	R ²	Adj. R ²	ΔR^2	Beta	Sig.
1	CCON1	.142	.020	.017	.020	.142	.013

Dependent Variable: ARCSPERF

Model	Predictors	R	R ²	Adj. R ²	ΔR^2	Beta	Sig.
1	DCAS1	.175	.031	.028	.031	.175	.002

Dependent Variable: SUBJLOG

Model	Predictors	R	R ²	Adj. R ²	ΔR^2	Beta	Sig.
1	CCON1	.458	.210	.207	.210	-.458	.000

Dependent Variable: SUBJLOG

Model	Predictors	R	R ²	Adj. R ²	ΔR^2	Beta	Sig.
1	DCAS1	.407	.165	.163	.164	-.407	.000



Stress before (STRBEF) upon (initial) CAS (computer anxiety, confidence and liking) (Stepwise)

Multiple regression was conducted using the three CAS attitude scales on Test 1 as independent variables, and 'stress before' (STRBEF) as the dependent variable. The variable entered on the first step was CANX1 (Computer Anxiety on Test 1) (see Table 3.10). The most obvious feature of the output was the multiple correlation coefficient (Multiple R) which was given as 0.392 (with R square being 0.154). The decision of the stepwise program was to drop all the other independent variables from the final equation. Only computer anxiety may be regarded as a significant predictor of 'stress before'.

Stress before (STRBEF) upon (initial) DCAS (Enter)

Simple regression was conducted using the DCAS attitude scale on Test 1 as independent variable, and 'stress before' (STRBEF) as the dependent variable. Using the 'enter' procedure in SPSS, Multiple R equalled 0.348 and R square 0.121, suggesting that DCAS1 accounted for a considerable amount of the variance in 'stress before' (see Table 3.10). In the equation of the regression, the variable DCAS1 was significant.

Stress after (STRAFT) upon CAS (Stepwise)

Multiple regression was also conducted using the three attitude (sub)scales on Test 1 as the independent variables, and 'stress after' (STRAFT) as the dependent variable. The variable entered on the first step was CCON1 (Computer Confidence on Test 1) (see Table 3.10). The multiple correlation coefficient (Multiple R) was given as 0.329 (with R square being 0.108). The decision of the stepwise program was to drop all the other independent variables from the final equation. Only computer confidence may be regarded as a significant predictor of 'stress after'.

Stress after (STRAFT) upon DCAS (Enter)

Simple regression was conducted using the DCAS attitude scale on Test 1 as independent variable, and 'stress after' (STRAFT) as the dependent variable. Using the 'enter' procedure in SPSS, Multiple R equalled 0.306 and R square 0.093, suggesting that DCAS1 variables accounted for a fair amount of the variance in 'stress after' (see Table 3.10). In the equation of the regression, the variable DCAS1 was significant.

Subjective ratings (CPTOT) upon CAS (Stepwise)

Multiple regression was conducted using the three attitude (CAS) (sub)scales on Test 1 as independent variables, and subjective ratings (CPTOT), measuring stress, frustration, anger, control, etc after computer interaction, as the dependent variable.

The variable entered on the first step was the CCON1 (see Table 3.10). The multiple correlation coefficient (Multiple R) was given as 0.555 (with R square being 0.308). The decision of the stepwise program was to drop the other independent variables from the final equation. Computer confidence may be considered as a strong predictor of stress, frustration, anger, control, etc as reported after computer interaction and as measured by the subjective ratings (CPTOT).

Subjective ratings (CPTOT) upon DCAS (Enter)

Finally, a simple regression was conducted using the DCAS on Test 1 as independent variable, and subjective ratings (CPTOT) as the dependent variable. Using the 'enter' procedure in SPSS, Multiple R equalled 0.503 and R square 0.253, suggesting that DCAS1 accounted for a good amount of the variance in the subjective stress ratings (see Table 3.10). In the equation of the regression, the variable DCAS1 was significant.

Performance (ARCSPERF) upon CAS (Stepwise)

Multiple regression was conducted using the three CAS attitude scales on Test 1 as independent variables, and performance as the dependent variable. The variable entered on the first step was CCON1 (Computer Confidence on Test 1) (see Table 3.10). The most obvious feature of the output was the multiple correlation coefficient which was given as 0.142. R square equalled 0.020. The decision of the stepwise program was that the increment in R with the inclusion of the variables CANX1 and CLIK1 was not robust, and so those variables were dropped from the final equation. Only CCON1 may be considered as a very weak predictor of computer performance. As R square suggests, computer confidence accounted only for about 2% of the variance in performance.

Performance (ARCSPERF) upon DCAS (Enter)

Simple regression was conducted using the DCAS attitude scale on Test 1 as independent variable, and performance as the dependent variable. Using the 'enter' procedure in SPSS (for simultaneous regression), multiple R was 0.175 and R square only equalled 0.031, suggesting that the independent variable accounted only for little (3%) of the variance in performance (see Table 3.10). However, in the equation of the regression, the variable DCAS1 was significant.

Subjective difficulty (SUBJLOG) upon CAS (Stepwise)

Multiple regression was also conducted using the three attitude (sub)scales on Test 1 as the independent variables, and subjective difficulty (SUBJLOG) as the dependent variable. The variable entered on the first step was the CCON1 (see Table 3.10). The multiple

correlation coefficient (Multiple R) was given as 0.458 (with R square being 0.21). The decision of the stepwise program was to drop the other independent variables from the final equation. Only computer confidence may be considered as a fairly strong predictor of subjective difficulty.

Subjective difficulty (SUBJLOG) upon DCAS (Enter)

Simple regression was conducted using the DCAS attitude scale on Test 1 as independent variable, and performance as the dependent variable. Using the 'enter' procedure in SPSS (for simultaneous regression), multiple R was 0.407, and R square equalled 0.165, suggesting that the independent variable accounted for a moderate amount of the variance in subjective difficulty (see Table 3.10). In the regression, the variable DCAS1 was significant.

Experience and attitude on stress and performance

Stepwise multiple regressions were also conducted (not shown in Tables) to see whether attitude or experience carries more weight in predicting stress and performance. Within this context, computer experience was expressed as a dummy variable (D4) that contrasts the 'high' experience group (group 4) with all others. As seen in chapter two, the 'high' group was the only group that significantly differed from all others on initial computer attitude as well as on change on attitude as a result of a computing course.

So, stepwise regressions were conducted in order to assess the effects of adding the 'experience' (D4) dummy variable to the attitude variables in predicting stress and performance, and to look at the contribution of the attitude and experience variables to the outcome. The intention here was to see whether the effects on stress and performance due to attitudes were really just a result of experience. In other words, if (a) attitude is a result of experience and (b) stress is a result of attitudes, then is (b) due to (a)? In almost all cases experience contributed nothing to the variance.

For each of the regressions, the dependent variable was one of the following: performance (ARCSPERF), subjective difficulty (SUBJLOG), stress before computing sessions (STRBEF), stress after computing sessions (STRAFT), or the subjective ratings indicating stress, frustration, anger, etc as reported after computer sessions (CPTOT).

Computer anxiety (CANX1), computer confidence (CCON1) and computing experience (D4) were used as independent variables. These attitude variables were selected on the basis of their correlation with the dependent variables. Also, CCON1 was selected for its primarily strong significant contributions in the previous regressions, and CANX1 for its contribution in predicting 'stress before', and in order to investigate the extent to which computer anxiety could predict the dependent variables in relation to experience (seen as an interesting question).

This analysis indicated that computing experience played no part in predicting performance, added nothing to the variances of subjective difficulty, 'stress after' and subjective ratings, but significantly contributed, by adding 2%, to the variance of 'stress before'.

In general, regressions suggested no artefact of collinearity (as indicated by the 'tolerance levels' provided by SPSS.8) either between any CAS subscales or between CAS subscales and experience.

3.4 Discussion

The results of this study relate to its aims as follows.

The first of the main research questions was: Does a computer session change levels of stress? Is computer operation / use per se stressful?

There were two possible hypotheses about the effects of a computer terminal session on stress. One of them (hypothesis 1b), was that students would experience lower stress after computer interaction rather than before computer interaction. Thus, it was hypothesised that the stress scores on the SACL would be higher **before** the computer session than **after** the computer session; this was hypothesised because anticipation of difficulty with computing was assumed to lead subjects to higher stress scores before the terminal session than after the session (where students may have, in the main, managed to accomplish the set tasks).

In particular, within hypothesis (1b), it was hypothesised that students would have felt some stress during and after a preceding lecture about computers and their use in the University as well as have anticipated some difficulties and problems associated with the operation of computers. These problems were thought to have been eased and alleviated after actual, and under guidance, use of computers.

However, the results of this study contradicted this hypothesis, and, only to a certain extent, confirmed hypothesis (1a), that computer interaction would be stress inducing. Indeed, computer interaction was stress inducing but only transiently, in the first out of four weeks of data collection. Stress scores **after** computer interaction increased significantly for the first week of the practicals, had a tendency to increase for the second week (although this result was not statistically significant), and remained approximately the same for the third and fourth week. However, in considering the finding that in most occasions computer interaction neither induced nor reduced stress levels, this result seemed rather to confirm Kumashiro et al's findings (1989), but to contradict Hudiburg's studies (1989a, 1989b, and 1990) as well as other researchers reviewed in the Introduction.

More specifically, the present findings, that computing per se can only be transiently stressful (but in the main is not stress inducing), seem to go along with Kumashiro et al's (1989) argument that it is difficult to conclude that stress is increased just by interaction with the computer. On the other hand, the present results, that stress in the main does not increase with computing activities (increases only transiently), seem, to a certain extent, to negate Hudiburg's (1989, 1990) argument that computer stress increases together with the amount of time spent working on the computer. In other words, Hudiburg's suggestion was that the more people used computers, the more likely they were to experience a hassle; and the more the 'hassles', the more likely they were to experience higher stress.

According to the present results, the answer to the first of the main research questions is that a computer session **can** change (increase) levels of stress; and computer operation **can** be per se stressful. However, the increase of stress from before to after computer interaction is rather transient (within the present research, there was such an increase only for the first week's computer session).

However, the frequency results, derived from the 'subjective ratings' (CPTOT), indicated that a large proportion of subjects appeared to feel stressed (an average of 35%), frustrated (34%), and out of control (39%). This result seems to contradict the findings derived from the use of Cox's SACL. According to SACL, not only the overall experienced stress appears to be low, but also the computing session, as discussed before, produces only a transient (i.e. for the first week only) significant stress increase. It may be that, in contrast to SACL (which was used to indicate change of stress), the subjective ratings provide an indication of computer stress (and related feelings) as experienced in absolute terms, although reported after computer sessions. It should be noted here that the correlation between the subjective ratings (CPTOT) and 'stress before' (STRBEF, as measured by SACL) was 0.47; and the correlation between CPTOT and 'stress after' (STRAFT, as measured by SACL) was 0.61.

Present findings derived from the use of Cox's SACL are somewhat at odds with Weinberg's (1980, 1981, and 1983), Paul's (1982) as well as Brosnan's (1998) and other researchers' widely reported findings that roughly 30% of computer users show persistent symptoms of computer-related stress, cyberphobia, and/or computer anxiety. However, present findings derived from the use of the subjective ratings seem to confirm, for example, Weinberg's and Brosnan's reports. So, the present results, at least as derived from the subjective ratings, seem to fit with other claims of high incidence of computer stress.

On the other hand, it maybe that although SACL is a good measure in measuring change of stress, it is not however designed to measure absolute incidence of stress, since, among other issues, lacks of any 'normative data'. In support of this, Kumashiro et al (1989) seem to have

used SACL for the purpose of comparisons, something for which SACL appears to be appropriate.

As a conclusion, in considering the question if computing causes stress: If this is defined operationally, as increase in stress from before to after a session (as with Cox's SACL), then the answer is that computing **can** cause stress. However, this happens only initially and only for users with high prior experience. If stress is defined as some overall subjective measure, then more than 30% of users appear to be stressed, frustrated or out of control when computing [(as indicated by the subjective ratings (CPTOT))]. As previously discussed, Cox's SACL may be useful for relative scores – but not for absolute scores. Thus, SACL and CPTOT appear to measure two different things. Within the scarce literature on computer stress, it appears that similar measures may produce similar results. In particular, Kumashiro et al (1989) used SACL for comparisons. Their results seem to go along with the present findings based on SACL. And Brosnan's (1998) results, based on the use of survey measures (similar to CPTOT), seem to go along with the present findings based on CPTOT.

The second research question was: What is the effect of prior experience on computer stress? In particular: a) Does prior experience affect change of stress from before to after a computing session? And b) Does prior experience affect overall levels of stress?

Within hypothesis (2a) (see section 3.1.5: Conclusions, research questions and hypotheses), it was hypothesised that those subjects with greater initial computer experience would show lower changes of stress from before to after computer interaction, as well as experience less stress before and after computer interaction, than those subjects who have relatively less experience. These hypotheses were formed because it was thought that interaction with computers would not only play an important role in affecting computer stress but also show the more experienced users to adapt easier in a relatively new computer situation.

a) Comparisons of pre-session to post-session stress indicated that post-session stress scores were significantly higher than pre-session stress scores only for the first week of the practicals, and, in particular, only for the first week of the 'high' users.

An initial interpretation could be that generally the increase may have been because on the first week there was the very first contact of the subjects with computers in the university and psychology department, and students found the first introductory steps of operating the university computer terminals stressful.

However, this increase was found to be mainly due to the 'high' experience group. In accordance with the hypothesis, it was expected that the highest computer experience subjects would show the lowest changes of stress from before to after computer sessions, since it was

thought that their computer experience would promote an easier adaptation to a relatively new computer situation, compared to the other groups of experience. However, although 'high' users started with the lowest levels of stress, their stress score was the only one to be increased significantly by the end of the first week's session.

This surprising result may have been because 'high' users had more positive initial attitudes towards computers compared to all other groups, and, thus, had associated computers with confidence, liking, and generally positive thoughts and feelings; so, the discrepancy between their expectations and the actual computer sessions was greater than the same discrepancy for other users who had less contact or no contact with computers at all before these sessions. This may explain to a certain extent why students with the highest relatively computer 'expertise' felt so negatively over their computer sessions. This 'violation' of expectancies could relate to some of the general literature on stress. For example, a parallel may be drawn here with Mandler's (1975) view on violation of expectancies and interruption of plans.

b) An ANOVA, for the four experience groups, on their stress scores **before** computer sessions (as collapsed across four weeks) showed that computing experience prior to this study was a predictor of their initial ('before') stress scores. In particular, subjects who have experienced one or more of an advanced range of computer uses (i.e. program development and/or statistical analysis and/or control - as indicated on the first question of the DCAS, Part II), have overall lower initial stress scores than naive computer users or those who have only used computers in 'every day' 'easier' applications (i.e. communications and/or word processing and/or instructional / educational programs). No significant difference in initial stress was found for the 'game players'.

Similarly, an ANOVA, for the four experience groups, on their stress scores **after** computer sessions (each collapsed across four weeks) showed that computing experience prior to this study was a predictor of their final ('after') stress scores. High users have overall lower final stress scores than those subjects without any prior computing experience. No significant difference in final stress was found for those who have only used computers in 'every day' 'easier' applications or for those who only play computer games.

This result indicated that in general the preceding computer tasks were related to similar amounts of stress after sessions for the 'medium' and 'high' users. This is possibly because the level of the computing skills required to complete these tasks was not only below the 'high' users expected computing abilities but also below the 'medium' users computing skills.

This finding is not consistent with the suggestion by Hudiburg (1989a) that the number of hassles and the amount of stress increased with number of hours of computer use and consequently with computer experience. In particular, Hudiburg suggested that the more the

experience people have with computers, the more likely they are to experience 'hassles' and negative feelings/moods; and the more the 'hassles' people have, the more likely they will be to score higher on stress. However, this could be regarded as an issue of 'opportunity'. In particular, Hudiburg's experienced users may have encountered more hassles mainly because they use computers more. In the present study, although experienced users seem to have lower levels of stress both before and after computer sessions, however, they do show increased levels of stress over a session more than any other experience group.

Part of the research question (2) was: What is the effect of prior experience on computer performance?

Within hypothesis (2b), subjects with greater initial computer experience were hypothesised to perform better and experience less subjective difficulty on various computer tasks than those subjects with relatively less experience. However, the results showed that there was no effect of computer experience on computer performance, i.e. prior experience did not seem to affect performance. Nevertheless, there was some effect of computer experience on subjective difficulty, significant only for the second week of the practicals, and due to the 'high' and 'medium' experience groups.

So, for example, high users do not achieve higher performance scores than naive computer users or those who have only used computers in 'every day' 'easier' applications or games, as somebody may have expected. However, and as expected, subjects who for example have experienced at least one of the advanced range of computer uses will have less subjective difficulty than subjects with less prior computer experience; and subjects who have used computers, for example, only for communications and/or word processing will have less subjective difficulty than those subjects who have only played computer games. No significant result on subjective difficulty was shown for subjects with no previous computing experience.

Part of research question (3) was: How do computer attitudes (including computer anxiety, computer confidence, and computer liking) relate to computer stress?

Results of correlations indicated that all three variables of computer-related stress ['stress before' and 'stress after', both measured by SACL, and subjective ratings taken after (CPTOT)] were significantly and negatively correlated with all measures of attitudes towards computers (computer anxiety, confidence and liking, as indicated by CAS, and general computer attitude, as measured by DCAS). This was an interesting result which suggested that, if a person experiences stress when dealing with computing, this has a lot to do with his/her attitudes (including anxiety) towards computers. This finding seems to contradict Hudiburg's (1989)

results where computer-related stress was found to be relatively independent of attitudes towards computers.

Previous research on computer anxiety has found a close relationship between computer anxiety and computer attitudes (Nickell and Pinto, 1986; Rosen, Sears, and Weil, 1987). The difference between the relationships of computer anxiety to computer attitudes and computer-related stress to computer attitudes may be to a certain extent depended on the differences between the definitions and the measurements of the two constructs. It may also be depended on the context, i.e. if the variable is used dependently or independently. The present results suggested that there is a close relationship between computer anxiety and computer-related stress. However, further research should address this issue separately.

Within the present research generally, computer anxiety has been treated as an independent 'attitude' construct, whereas stress as a 'non-attitude' dependent one. However, this distinction has not been clear in the anyway scarce literature on computer stress. It is even sometimes the case that these two constructs have been used interchangeably in previous research.

In considering the present chapter, if there is no change induced by a computer session in the SACL's (Cox et al, 1978, 1985) score, then one possibility is that the SACL score could be only another measure of general anxiety, which, according to previous studies (e.g. Howard, 1984, 1986; Raub, 1981), relates closely to other state, trait, and computer anxiety measures.

It should be recalled here that correlations should be interpreted as indices of association between variables, and not as cause-and-effect relationships. A cursory explanation of the foregoing statistical results would be that negative computer attitude was a cause of computer-related stress. However, a closer examination may suggest that fear of the technologically unknown, a major component of computer-related stress (and of computer anxiety, too), may be the cause for negative computer attitude. In other words, although computer-related stress and attitudes were significantly related to one another, it was not clear which variable was the cause and which the effect; or the case may, indeed, be that a third different variable could be the cause for both computer attitude and computer-related stress.

The relation between computer attitude and computer-related stress was further explored on the basis of the results on multiple regressions.

In particular, the multiple regression of 'stress before' upon three attitude variables (CAS's computer anxiety, confidence and liking) (see Table 3.10) showed that the only predictor of computer related stress before computer interaction was computer anxiety. In accounting for about 15% of the variance in initial stress, computer anxiety appears to be the key attitude variable in determining stress before computer interaction.

It makes sense that computer anxiety (CANX1) should significantly contribute to stress prior to computer sessions. This could be interpreted as related to anticipatory (to a computer session) anxiety.

Moreover, when the 'experience' (D4) dummy variable was added to the independent variables of computer anxiety and confidence, experience **did** enter the regression equation. It was found that experience contributed minimally to the model (about 2%) and thus had a small effect in predicting stress before computer interaction.

Finally, the regression of only DCAS1 on initial stress showed that general computer attitude accounted for about 12% of the variance in 'stress before'.

These findings suggested that the greater the subjects' computer anxiety, the more the stress they were likely to experience before completing various computer tasks; and the more positive their general attitude towards computers, the less their stress before computing sessions.

The multiple regression of 'stress after' (as measured by SACL) upon the attitude variables of computer anxiety, confidence and liking (as measured by CAS) (see Table 3.10) showed that the only predictor of computer related stress after computer interaction was computer confidence (accounted for 11% of the variance in 'stress after'). This suggested that the greater the subjects' confidence, the more the stress they were likely to experience after completing various computer tasks.

When the 'experience' (D4) dummy variable was added to computer anxiety and confidence, experience did not enter the regression equation and added nothing to the variance of 'stress after'; thus, it was concluded that stress after computer interaction was not a function of experience.

Finally, the regression of only DCAS1 on 'stress after' showed that general computer attitude accounted for about 9% of the variance in 'stress after'.

The multiple regression of subjective ratings upon CAS's attitude variables showed that the only and strong predictor of computer related stress, anger, helplessness, frustration, (as reported after computer sessions) was computer confidence. Confidence accounted for a 31% of the variance in subjective ratings. This suggested that the greater the subjects' computer confidence, the less the stress, anger, etc the subjects were likely to report after completing various computer tasks.

When the 'experience' (D4) dummy variable was added to the independent variables of computer anxiety and confidence, as before, experience did not enter the regression equation

and added nothing to the variance of the subjective ratings. It was concluded that stress, frustration, anger, etc as reported after computer interaction was not a function of experience.

Finally, the regression of only DCAS1 on stress, frustration, anger, etc showed that general computer attitude accounted for about 25% of the variance.

In summary, prior computer attitudes relate to stress experienced in a computing session. All attitude variables correlate with all stress variables. However, it is mainly computer confidence, **not** computer anxiety, as both measured by CAS, that accounts for most of the variance in the stress variables. Also, computer anxiety seems only to relate with anticipation of a computing situation, whereas computer confidence appears to relate with dealing with the computing situation.

The second part of research question (3) was: How do computer attitudes relate to computer performance? In particular, it was expected that students with more favourable prior attitudes (and less anxiety) towards computers will achieve higher levels of computer performance and will experience less subjective difficulty in completing a number of computer tasks. Thus, initial computer attitudes (including computer anxiety), as measured by CAS and DCAS, were hypothesised to positively (cor)relate with levels of computer performance and subjective difficulty.

Computer performance, as hypothesised, was an overall significant correlate of computer attitudes. In particular, students with higher levels of performance on actual computer tasks, had more favourable attitudes towards computers and lower levels of computer anxiety. Thus, although correlations cannot establish causation, it seems reasonable that if students' computer attitudes could be improved and computer anxiety reduced, then an accompanying improvement in computer performance and productive use of computers in general, might occur. This, of course, may just depend on prior experience, although no effects of prior computer experience on performance were found. On the other hand, it may be that people tend to rate in computing attitudes (or anything else) higher, if they are good at it.

In general, results in the present as well as in the previous chapter, may suggest that mastery and control over computers gained through computer experience are important in determining computer attitudes and, to a lesser extent, the levels of computer-related stress; however, they are not vital in relation to computer performance.

In considering the relation between attitudes and subjective difficulty, all correlations between computer attitudes (including anxiety) and the amount of subjective difficulty were significant. These indicated that students with more favourable attitudes towards computers and lower levels of computer anxiety, experience significantly less subjective difficulty when

completing different computer tasks. It would appear reasonable to speculate that this experience of low difficulty, in turn, improves even further the computer attitudes and reduces even further the computer anxiety.

The multiple regression of performance upon CAS's attitude variables showed that the only and weak predictor of computer performance was computer confidence accounting for only 2% of the variance in performance.

When the 'experience' (D4) dummy variable was added to the independent variables of computer anxiety and confidence, as before, experience did not enter the regression equation and added nothing to the variance of performance. It was again concluded that, in this context, performance was not a function of experience.

Finally, the regression of only DCAS1 on performance showed that general computer attitude accounted for only about 3% of the variance.

The multiple regression of subjective difficulty upon CAS's attitude variables showed that the only and key predictor of difficulty was computer confidence. Confidence accounted for a 21% of the variance in subjective difficulty. This suggested that the greater the subjects' computer confidence, the less they were likely to experience difficulty when completing various computer tasks.

When the 'experience' (D4) dummy variable was added to the independent variables of computer anxiety and confidence, as before, experience did not enter the regression equation and added nothing to the variance of subjective difficulty. It was concluded that subjective difficulty was not a function of experience.

Finally, the regression of only DCAS1 on subjective difficulty showed that general computer attitude accounted for about 17% of the variance.

In summary, in terms of correlation, initial computer attitudes relate to computer performance – but more clearly to perceived difficulty. (All attitude variables correlate with performance and, even stronger, with difficulty). In terms of regression, once again, it is mainly computer confidence that relates to subjective difficulty. However, there is little or no effect of confidence on performance.

Research question (4) was: Does information on attitude variables (as measured by CAS and DCAS) predict any of the variance of computer stress and performance?

As discussed before, the main points of the regressions are:

1) Computer confidence is the strong predictor variable in determining subjective ratings, the fairly strong variable in predicting 'stress after', the key variable in predicting subjective

difficulty, and a weak variable in predicting performance. It is only where the dependent variable is 'stress before' that computer anxiety and not computer confidence accounts for most of the variance in the outcome.

2) Computer anxiety is the key predictor of 'stress before'; however, it does not add anything to the variance of any other dependent variable.

3) DCAS1 appears to be a good predictor of mainly subjective ratings and subjective difficulty.

4) Computer liking does not appear to account for the variance in any of the outcome variables.

CHAPTER FOUR

Personality, and attitude/anxiety, stress and performance in computing

4.1 Introduction

4.1.1 Personality and Stress / Anxiety

"Psychological, physiological, and behavioural responses to stress are products of the situation and the individual - including specific personality traits and characteristics, and behaviour patterns based on attitudes, needs, values, past experience, life circumstances and ability (i.e. intelligence, education, training, learning, etc). Thus, the impact of a stressor is not invariant, but individual modifiers may either be predisposing or protective in the response to stress" (Cooper and Sutherland, 1988).

"Modifiers are identified by Beehr and Newman (1978) as 'the personal facet'. This includes any characteristic of the human being that influences an individual's perception of stressful events, and incorporates the physiological and psychological condition of the person, and their life stage characteristics. Internal qualities of the individual are discussed by Schuler (1980) under the categories of needs and values, abilities and experience, and personality characteristics of the person. All are seen as important to the individual's perception of stressors and stress" (Cooper and Sutherland, 1988).

"Certain personality characteristics are considered significant modifiers of response to stress, since they may significantly render the person more, or less, susceptible to stress" (Cooper and Sutherland, 1988). This chapter discusses the relevance of only certain personality types (or certain individual differences) to computer stress, anxiety, attitudes, and performance. In particular, this chapter is specifically concerned with the possible roles that the traits and/or behaviour styles of Locus of control, Type A, Extraversion, and Neuroticism play in relation to computer stress, computer attitudes (including computer anxiety), and computer performance.

4.1.2 Locus of control, stress, and computer attitude

4.1.2.1. Locus of control

One personality characteristic which may influence people's computer attitudes, computer anxiety, and stress has been described as the 'locus of control'. The concept, first developed in the mid 1960s by J.B. Rotter (and expressed as "Generalised expectancy of reinforcement"), looks at the extent to which individuals feel they have control over situations and life events. According to the personality variable 'Locus of Control', people can be

classified as internal or external types. By definition, the two personality types view themselves and their interaction with the world in two respective different ways. In particular, internal locus of control types (referred to as 'internals') perceive and interpret the forces that control their lives to be located within themselves, and they believe that events happening to them depend upon and are controlled by their own behaviour.

On the other hand, external locus of control personality types (referred to as 'externals') perceive and interpret the forces that control their lives to be located outside themselves, attribute control to the external environment, and believe or feel that luck, (chance, fate, or destiny), and powerful others are in control of their lives, or events in their lives are unpredictable because of the great complexity of forces surrounding them (Rotter, 1966; Levenson, 1978; Lefcourt, 1979; Spector, 1982; Woodrow, 1990).

Locus of control is not an either/or measurement, but rather a continuum between two contrasting personality types; most people fall between the two extremes forming a continuous distribution of locus of control beliefs. Locus of control is thought to be a relatively enduring dispositional characteristic, although certainly modifiable through experience.

So, locus of control, as a relatively stable characteristic (Rotter 1966), has been identified and frequently used as an internal moderator of response to stress. The concept is based on a social learning theory, 'interactionist' view of the person, in that the individual learns from the environment through 'modelling' and past experience. Reinforcement of certain behaviours affects expectancy and so eventually expectancy leads to behaviour (Cooper and Sutherland, 1988; Payne, 1988).

The locus of control theory has generally received a great deal of attention. Within the education field, 'internals' are frequently associated with academic success and greater motivation to achieve (Cooper et al, 1988). Studies of psychological adjustment and coping abilities have shown internals to be less anxious and better able to deal with frustration. The 'external', in contrast, appears "less psychologically healthy" (Peck and Whitlow, 1975). In addition, a number of studies have suggested that a person's perceived control over a situation is an advantage in managing environmental stress agents (Greer et al, 1970).

Locus of control refers to the degree of perceived control over a given situation. The 'internal' oriented person believes that personal decisions and actions influence the outcome. Believed control in the personal determination of events is viewed as a factor in the expectation of coping with a stressful situation; and so less threat is experienced by the 'internal' compared to the 'external' oriented individual, who tends to believe in luck or fate. However, although internals' perception of control may help reduce stress in most situations, internals may display more anxiety and even higher stress levels than externals, in situations perceived to

be not within their control (Cooper and Sutherland, 1988). Thus, the relationship between locus of control and stress responses can greatly depend upon the type of stress encountered.

Style of behaviour in response to a stressor also varies. Internals tend to seek information and engage the problem, whereas externals are more likely to react with helplessness (Cooper and Sutherland, 1988). However, Krause and Stryker (1984) "suggested that extreme externals are vulnerable to stress because they are less likely to bother taking positive actions, whilst the high internals are paralyzed by their own guilt since they believe their failure to cope is their own fault" (Payne in Cooper and Payne, 1988).

Again in his review, Payne points out that Syrotnick and D'Arcy (1982), in studying 854 employed males, reported that externals used more social support under pressure than internals did, but came to the conclusion that locus of control does not have extensive moderator effects on stress(or)-(di)stress relationships. However, in studying 171 nurses, Parkes (1984) found that the internals reported more adaptive coping responses, and this was particularly true when the situations were cognitively appraised as potentially controllable and important to the subject.

There is a lot of research indicating that internals show more motivation, achievement, and better performance than the externals. For example, DeSanctis (1982) reported that internals have greater motivation, make more effort, utilise more resources, and spend more time in making decisions than externals; whereas Rotter (1966) pointed out that internals "are likely to be more overt in striving for achievement". Broedling (1975) found that internal locus of control employees were more motivated to work, and perform better than externals; and Lefcourt (1972) and Phares (1976) discovered that internals engage in greater information search activity. In addition, Zmud (1980) reported that internals request more information than externals, leading DeSanctis (1982) to hypothesise and (after research) confirm that internals tended to use a computerised decision support system more than externals.

Subsequently, an internal locus of control orientation has been found to be a major characteristic of the 'hardy personality' types (Kobasa, 1988), who are able to maintain good health despite high stress levels.

In considering the majority of the general relevant research, it would be reasonable to speculate that internal locus of control personality types will have confidence in their own ability to master and control computers, just as they have been confident and able in controlling and mastering other challenges. Hence, it would be expected that internals will show a lower level of computer anxiety and more favourable attitudes towards computers than externals.

This argument may also provide some justification for the inclusion of locus of control as a possible correlate of computer stress, anxiety, and (after considering the relation between attitude and anxiety), attitudes. If internal locus of control personality type individuals are believed to be better equipped personality-wise to handle threats, they could also be expected to be less anxious or stressed in a threatening situation, such as in using or in anticipation of using computers.

A final point to be made is that research has suggested that locus of control is not a unidimensional scale. There may be different domains of control, e.g. Paulhus Spheres of Control: 'personal', 'interpersonal' and 'socio-political'.

4.1.2.2. Studies on Locus of control, and computer attitudes, stress, performance and experience

Research on perception of locus of control in relation to computer attitudes, stress, experience, and performance is rather limited and started mainly during the early eighties.

Locus of control of causal beliefs is a psychological attribute that has been already linked with computer use in education. Like computer attitudes, the locus of control construct could be seen as a cognitive and/or affective characteristic, which can be shaped through experiences (e.g. Griswold, 1982).

In general, experiencing control means to have an impact on the conditions and on someone's activities in correspondence with some higher order goal (Frese, 1987). A person exerts control when he/she has influence over his/her actions and over the conditions under which he/she acts. [An action consists of a (variable) sequence: goal development and goal decision, plan development and decision, execution of the action and use of feedback (Frese and Sabini, 1985; Norman, 1986)]. Thus, having influence means to be able to decide what goals, what plans, and what kind of feedback a person uses under what conditions. The less the environment provides the freedom to decide, the less the control a person has.

Generally, control at work, technology, and computers has been shown to have an impact not only on stress-effects but also on performance (e.g. Frese, 1986, 1987; Semmer and Frese, 1987; Frese et al, 1987; etc). Results from the literature suggest that the concept of control is one of the important issues for the use of computers and the corresponding feelings and attitudes.

Workers in a variety of occupations have been and are being faced with technological change which affects their job opportunities, job tasks, and work environments. Of particular concern to industry and governments has been the problem of worker adaptation to these

changing job conditions. Burn's (1977) study was designed to investigate a portion of this adaptation process and the influence of situational and personality factors on the workers' perception and handling of job-related technological change.

Primary focus was placed on the role of control orientation (locus of control and autonomy)

"an important variable in a wide variety of human behaviour studies and an important concept in social psychological theories of attribution of causality, locus of control, learned helplessness, and reactance" (Burn, 1977).

Generally, the questions emerging from Burn's study were: a) how people's perceived locus of control relate to their handling of job-related change when the change is brought about by computers? Or b) what is the relationship between perceived locus of control and attitudes towards computers?

Research on locus of control suggested that internals were more likely to take the initiative to become knowledgeable about computers and to persist in their efforts, (even in the face of problems), until their goal(s) were attained. In addition, as their knowledge about computers increased, their attitudes towards computers also became more positive and their performance improved too; this, in turn, led to further gains of computer experience and knowledge (e.g. Horak and Horak, 1982; Horak and Slobodzian, 1980).

Furthermore, findings from studies among student computer novices, and on causal - attributional beliefs (or locus of control), supported the prediction that students whose locus of control was internal gained more from 'low-structure' situations than students whose locus of control was external (e.g. Horak and Horak, 1982; Horak and Slobodzian, 1980).

In his 1985 study, Wesley et al, by using Rotter's locus of control scale (Rotter, 1966), found that pre-service teachers with internal locus of control were more likely to engage in computer related activities than their peers with external locus of control. These findings have suggested that 'internal' individuals have more positive attitudes towards computers, better performance with computers, and are more motivated to become computer literate, than those whose locus of control is external.

In addition, Wesley et al (1985) found that internally - oriented subjects scored significantly higher on the cognitive part of the MCLAA (Minnesota Computer Literacy and Awareness Assessment, Anderson et al, 1979) than did externally - oriented subjects. However, the two groups scored similarly on the affective part of this test.

Wesley et al, as well as some of the studies mentioned below, suggested that both computer attitudes and perceptions of locus of control are important and major factors in motivating one

to gain computer knowledge and experience, or, in other words, to become computer literate.

Griswold (1982) argued that locus of control may be a very important factor in the development of computer awareness and related attitudes. In particular, he suggested that internally - oriented individuals should be less intimidated by computers than externally - oriented individuals, more able to cope with the demands of learning to use a computer, and more competent in developing efficient programming skills. In his study among education majors, Griswold (1983) also found that locus of control explained more of the variation in computer awareness than did age, gender, number of mathematics courses and arithmetic skill.

Morrow et al's study (1986) examined ten potential correlates of computer anxiety. The purpose of this study was to examine the potential sources of such anxiety and to increase our understanding of the human-computer interface.

The subjects were 108 male and 65 female undergraduate college students enrolled in an introductory management class at a USA Midwestern university. Morrow et al (1986) measured computer anxiety, computer experience, computer knowledge, computer ownership avoidance, locus of control, rigidity, anxiety about mathematics, typing speed, video game ownership, and video game avoidance.

Rigidity was measured because computer anxiety may reflect a generalised resistance to change; anxiety about mathematics, as discussed in Chapter 1, has been hypothesised to be correlated with computer anxiety (e.g. Christiansen, 1982; Raub, 1981; Dambrot et al, 1985); typing speed behavioural index was included based on the assumption that a reluctance to use computers may be derived from a misconception that typing skills are a necessary prerequisite. Finally, in the case of locus of control, Rotter's (1966) 29-item Locus of Control scale was employed to determine whether individuals who hold external control beliefs are more computer anxious than are internally oriented individuals.

In considering Morrow et al's results, the critical point was that their correlations indicated that seven of the nine potential correlates were significantly related to computer anxiety. Only typing speed and video game ownership showed no relationship to the criterion. The correlates exhibiting the strongest relationships were computer experience, computer knowledge, mathematics anxiety, and locus of control (external scores were more anxious).

Furthermore, Morrow et al's results showed that self-reported behaviours (i.e. computer experience, computer knowledge, etc) explain more of the variance in computer anxiety than do personality / attitudinal correlates (e.g. locus of control, rigidity, and mathematics anxiety). This may imply that computer anxiety may be more a function of prior experience

(that is an easier modifiable condition), than a deeply entrenched attitude or personality trait, such as locus of control.

As discussed in Chapter One, Lee (1970) found that people often view the computer either 1) as a tool to be utilised, a machine-instrument of man's purposes and helpful in science, industry, etc, or 2) as a relatively autonomous entity which can perform the functions of human-like thinking. Similarly, Cancro and Slotnick (1970) espoused the hypothesis that man reacts to the computer either as a tool to be utilised or, alternatively, as a mind-controlling entity to be feared.

In Coovert and Goldstein's (1980) study those who view the computer as a tool to be utilised were considered as having a positive or favourable attitude towards computers, while those who view the computer as an autonomous or mind-controlling entity were considered as having a negative or unfavourable attitude.

The purpose of their first experiment was to determine the relation between (perceived) locus of control and attitudes towards computers. The main hypothesis was that internal (locus of control) subjects would, overall, have a more positive attitude towards computers than external (locus of control) subjects.

The subjects were 26 male and 42 female from the general subject pool of undergraduate students from a large Midwestern US university. A slightly modified version of Lee's scale of attitudes towards computers was administered. Lee's scale has seven questions which measure the extent people view the computer as a tool to be utilised (Factor I), and nine questions which measure the extent people portray it as an entity that can perform the functions of human-like thinking (Factor II). Subjects were also given to be filled out, Rotter's (1966) 29-question measure of internal-external locus of control.

Analysis of variance indicated that internal scorers had a significantly more positive attitude towards computers (i.e. on Factor I) than did external scorers. On the other hand, while internal subjects had a less negative attitude towards computers (i.e. on Factor II) overall than did external subjects, this difference was not significant (Coovert and Goldstein, 1980).

As was hypothesised, Coovert and Goldstein's first experiment illustrated that internal and external subjects have different attitudes towards computers, with internal subjects having overall a more positive attitude towards computers than external ones.

Although the Rotter internal-external locus of control scale appears valid (Phares, 1976), Levenson (1973) has pointed out that the evidence indicated that the internal-external scale may not be unidimensional. Levenson developed a new locus of control scale with three submeasures:

- a) Internal, i.e. the degree to which a person believes that the events in his/her life are under personal control;
- b) Powerful others, i.e. the extent to which a person believes that powerful others control their life events; and
- c) Chance, fate or destiny, which attempts to measure the extent to which chance is a perceived controlling force in a person's life.

The purpose of Coovert and Goldstein's (1980) second experiment was to find the relationship between Lee's two factors of attitudes towards computers and Levenson's dimensions of locus of control. As described before, Lee's Factor I measure the extent to which people view the computer as a tool to be utilised, and Factor II measures the extent to which people portray the computer as an entity that can perform the functions of human-like thinking.

In particular, it was hypothesised that those subjects who scored high on Lee's Factor I (indicating a positive attitude towards computers), would also score high on Levenson's internal dimension but score low on the 'powerful-others' and 'chance' dimensions. On the other hand, if those who score high on Lee's Factor II (indicating a negative attitude towards computers) really perceive the computer as a potential controlling force in their lives (Cancro and Slotnick, 1970), they should score high on Levenson's 'powerful-others' dimension but score low on the 'internal' and 'chance' dimensions.

The subjects were 20 male and 45 female from the general subject pool of undergraduate students from a large Midwestern US university. Again, the slightly modified version of Lee's scale of attitudes towards computers was administered. Subjects were also given to be filled out, Levenson's (1973) 24-question measure of locus of control (including internal, powerful-others, and chance/fate).

The subjects' score on both of Lee's factors (I and II) indicated their attitude towards computers. Of the 65 subjects, 28 had a higher positive attitude towards computers than a negative attitude (as indicated by their score on Lee's first factor as opposed to their score on his second factor), 35 subjects had scores indicating a higher negative attitude, while two subjects had the same score on both of Lee's factors.

Three one-way analyses of variances were performed between the scores of those with positive attitudes versus negative attitudes on Levenson's dimensions of internal, powerful-other, and chance. The analysis of variance indicated that those with positive attitudes towards computers scored significantly higher on Levenson's internal dimension than those with negative attitudes towards computers. In addition, although not statistically different, those with positive attitudes towards computers felt/perceived that powerful others

were less controlling in their lives than those with negative attitudes towards computers. The same was also true for the 'chance' dimension.

So, the hypothesis that those with a negative attitude towards computers view the computer as a powerful-other, and therefore as a potential perceived controlling factor in their lives, was not upheld.

The reason that those with negative attitudes towards computers (as measured by Lee's attitude scale) did not view the computer as a powerful other could be explained by Anderson and Orcutt's (1977) research on social interaction, dehumanisation, and the "computerised other". In particular, in their study, Orcutt and Anderson found that their subjects did not tend so much to personify the computer as much as they tended to dehumanise human others. Thus, although subjects may have actually viewed the computer as a perceived potential controlling factor in their lives, they may not have viewed the computer as a powerful (human) other.

Woodrow's study

Woodrow (1990) conducted a comprehensive study on the relation of computer attitudes to locus of control. Previous computing experience, word processing experience, age, and gender were also included as additional variables. Because of its distinctive qualities, such as comprehensiveness and clarity, it was thought that Woodrow's study is worthwhile to be discussed in a separate section.

Woodrow (1990) investigated the question of whether computer attitudes and perceptions of locus of control are factors independent of each other, or, in some way, correlated. Since both factors have an affective component, and both have been suggested as antecedents of computer literacy, as discussed earlier, it was hypothesised that a correlation exists between them. Specifically, Woodrow's (1990) hypotheses for his study were: 1) an internal perception of locus of control for achievement is positively correlated to computer attitudes; and 2) an internal perception of locus of control for achievement is more important and accounts for more variation in computer attitudes than does age, gender, previous computer experience or word processing experience.

The subjects in Woodrow's study were 106 students attending a computer course taught by Woodrow and offered for both undergraduates and postgraduates. They were all pre-service teachers, computer novices, and 63% were females. Firstly, a questionnaire was administered consisting of questions designed to collect background (demographic) data on the students (such as age, gender, etc). In addition, five computer attitude dimensions were selected for analysis: Computer Anxiety, Computer Confidence, Computer Liking, Computer Interest, and Computer - Ability Gender Equality. In particular, the Computer Attitude Scale of Loyd

and Gressard (1984) was used to measure the first three of these attitude dimensions. As discussed before, this instrument measures attitudes related to using and learning about computers (see Chapter 2, Method, for details). However, although Loyd and Gressard used their measure with either a four-item or a six-item Likert scale, a five-item scale, with responses from "strongly disagree" (1) to "strongly agree" (5), was adopted for this study in order to provide consistency with the other scales used (Woodrow, 1990).

Moreover, in Woodrow's study, Computer Interest related to the desire to learn about and use computers. The ten-item, General Attitudes towards Computers scale, developed by Reece and Gable (1982), was also administered to assess this attitude dimension; a five-item Likert scale was again used to record responses on this measure.

All attitude subscales were combined to produce a Computer Attitude Index calculated as the sum of the five specific attitude scales.

Finally, the achievement scale of the MMCS (Lefcourt et al, 1979) was used to measure the goal specific locus of control for achievement. This scale assesses those aspects of locus of control most closely related to specific expectancies associated with the academic learning of university undergraduates, i.e. achievement. The affiliation goal specific scale of MMCS was judged by the author to be irrelevant for the purposes of his study. Also, the choice of using the MMCS to measure perceptions of locus of control rather than a more general measure of locus of control such as Rotter I-E scale (1966) was based on the assumption that a goal specific measure of locus of control would be a better predictor of attitudes of university students than a general locus of control measure (Woodrow, 1990).

The locus of control for achievement scale of the MMCS consists of 24 items, subdivided among four specific attributions: six internally related items associated with ability and skill, six internally related items associated with effort and motivation, six externally related items associated with context and task difficulty, and six externally related items associated with luck or fate. Subjects rated their degree of agreement to each item on a 5-point Likert scale (ratings 1 to 5). Seven separate (though not independent) locus of control measures were derived from the responses to this questionnaire: four assessing beliefs regarding the specific causal attributions of Ability, Effort, Context, and Luck, and three assessing the composite attributions of Total Internality (i.e. Ability and Effort), Total Externality (i.e. Context and Luck), and the Locus of Control Index (i.e. Externality and Internality) (Lefcourt et al, 1979; Woodrow, 1990).

In considering Woodrow's results, it was found that Age and Computing Experience were negatively correlated, a result probably reflecting the growing trend towards school use of computers, while the positive correlation between Word Processing Experience and

Computing Experience was likely a result of the popularity of word processing among computer users.

Additionally, the significant positive correlation between the Locus of Control for Achievement Index and the Computer Attitude Index confirmed the existence of an interaction between computer attitudes and causal - attributional beliefs related to achievement.

However, special attention should be drawn to the finding that Locus of Control for Achievement Index was found to be positively correlated with the Computer Attitude Index, indicating a more positive attitude towards computers among externally-oriented students than among internally-oriented students (Woodrow, 1990).

This result negated previous findings and Woodrow's hypothesis which postulated that an internally-oriented locus of control for achievement would be positively correlated to computer attitudes. It was also different from the finding reported by Wesley et al (1985), that internals and externals scored the same on the affective subscale of the MCLAA.

Woodrow (1990) also found that there was no significant difference in previous computer experience between the internally-oriented and externally-oriented students. However, this finding contradicted Wesley et al's result (1985) that internally-oriented pre-service teachers were more likely to having had previous computer experience than their externally-oriented peers.

Woodrow's multiple regression analysis, using Computer Attitude Index as the dependent variable, showed that the combination of five predictor variables (i.e. Age, Gender, Locus of Control, Computer Experience, and Word Processing Experience) explained nearly 11% of the variation in the Computer Attitude Index. In particular, the Locus of Control for Achievement measure accounted for the largest portion of the variation in the Computer Attitude Index: 5.2%. This result showed that the computer attitudes of (computer novices) students were indeed determined, in part, by their perceptions of locus of control for academic achievement, not however in the way hypothesised. An external orientation of control, rather than the hypothesised internal orientation accounted for more variation in the Computer Attitude Index than did the other main effect variables. It should be noted here that Word Processing experience explained most of the rest of the variation in the Computer Attitude Index, 4.3%.

Further analysis of the subscales in Woodrow's study (1990) showed that the locus of control Ability subscale was positively correlated with two attitude dimensions: Computer Confidence and Computer Liking. It is suggested by Woodrow that the belief that achievement success is

ability driven, generates the attitudes of computer confidence and liking but it does not reduce computer anxiety nor guarantee interest in computers.

Moreover, the negative correlation between the Computer Attitude Index and the locus of control Effort subscale arised from the particular negative correlations between the Effort scale and all five of the attitude dimensions. Three of these correlations, with Confidence and Liking, were found to be significant.

According to Woodrow (1990), these strong relationships may have implied that those students (pre-service teachers) who felt that academic success depends upon effort were quite negative in all their attitudes towards computers. Perhaps such individuals feel that mastery of computers may be a difficult and effort - intensive task, so they tend to disengage from any close involvement with computers, to the point of forming negative attitudes about them.

However, such individuals were still motivated to engage in computer literacy studies. In spite of their negative attitudes and anxiety, these subjects must had been convinced that computer skills could be essential to them as professionals and were prepared to make the effort to acquire these skills. In Woodrow's concluding own words:

"Promotion of the user-friendly aspect of today's computers and the positive benefits of their use may help to overcome such conflicts and negative attitudes".

In further analysing Woodrow's results, those students who believed that luck influences academic achievement were generally positive towards computers. Specifically, the locus of control Luck subscale was positively correlated with both the Computer Confidence and Computer Liking attitude dimensions. A possible interpretation of these relationships is that individuals, who feel that achievement in general is influenced by fortuitous events, also feel that luck will enable them to acquire computer skills with little difficulty. This causal perception may enable such individuals to focus on the positive attributes of computers and to believe that it is only a matter of time and good fortune before they will have access to the power of computers.

Further, the locus of control Context subscale was not found to be correlated with any of the attitude dimensions. This result may be consistent with the issue that the computer attitudes among computer novices are formed in social contexts outside the classroom whereas the Context attribution relates achievement success with causal perceptions of the nature of courses and the behaviour of instructors. This attribution may be more influential in determining computer attitudes during or upon the completion of structured computer courses than among computer novices (Woodrow, 1990).

The relations among the four attributional locus of control subscores and the five attitude dimensions supported the findings of Collins (1974) and Lefcourt et al (1979) that internal and external ramifications are not necessarily negatively correlated. In particular, while the correlations (at the $p < 0.01$ level) between the attitude dimensions, Computer Confidence and Computer Liking, were positive with Luck (external), they were also positive with Ability (internal) and negative with Effort (internal).

The finding that the two internal attributions, Ability and Effort, led to opposing predictions concerning computer attitudes was also not without precedent. Dweck (1975), for example, found that

“ability attributions resulted in less effort to alter perceived failure patterns than did effort attributions. One attribution seemed to constrain the goal striving behaviour, while the other seemed to facilitate it”.

Similarly, in Woodrow's study (1990), Ability attributions seemed to facilitate positive computer attitudes, while Effort attributions seemed to correlate with negative computer attitudes. However, in the above study, the combined effect of all four specific causal attributions (i.e. Ability, Effort, Luck, and Context) was to foster more positive attitudes among computer novices whose locus of control for academic achievement was externally oriented than those whose locus of control was internally oriented. Nevertheless, this result was in contrast with other findings (e.g. Bar-Tal and Bar-Zohar, 1977) that academic achievement was positively related with an internal orientation of locus of control. The question raised here which may need further consideration is: what is the interaction between achievement and performance, in a computer literacy course, and locus of control and computer attitudes? It appears that computer performance and literacy is dependent upon many factors, many of which are interrelated. Locus of control for achievement and success, and attitudes towards computers seem to be two such factors.

In conclusion, Woodrow's study (1990) has found that, among students who are the least computer literate, the computer novices, those whose locus of control for academic achievement is externally-oriented, have more positive attitudes towards computers than their internally-oriented peers. This relationship was contrary to the hypotheses made on the basis of prior studies of the attribute of locus of control. Also, among internally oriented subjects, those who felt that Effort mainly determined academic success showed the most negative attitudes towards computers. On the other hand, students who believed that Lack influences academic achievement were generally positive towards computers. Finally, locus of control was found to account for more variation in computer attitudes than were the variables of age, computer experience, and word processing experience.

Locus of control and computer programming

This brief section is included for the sake of completeness in reviewing the locus of control and computing literature.

Four empirical studies have attempted to identify whether locus of control is related to computer programming performance (Chin and Zecker, 1985; Nowaczyk, 1983; Wilson, Mundy-Castle, and Cutts, 1989; Wesley, Krockover, and Hicks, 1985).

When studying 32 college students in an introductory computer science class, Chin and Zecker (1985) found that locus of control was a significant predictor of programming success and accounted for 14% of the total variance in their regression model, with internals being more successful than externals.

Nowaczyk (1983) found when studying 286 college students that locus of control was not a significant variable in his ability to predict programming success; however, he noted that the majority of the students tested as being internals, and he did not have a sufficiently large range of scores.

Wilson, Mundy-Castle, and Cutts (1989) found that for 15 black Zimbabwean females, LOGO scores were negatively related to internal locus of control; for 38 white Zimbabwean females, unrelated; and for 16 black and 36 white Zimbabwean males positively related to internal locus of control. Unlike previous studies, locus of control was measured using the Intellectual Achievement Responsibility Questionnaire rather than the Rotter's Locus of Control instrument.

Last, Wesley, Krockover, and Hicks (1985) reported that internals showed greater knowledge of computer hardware, software, programming, applications, and society issues; however, the programming component on which this review is focused is embedded in an overall measure of computer literacy.

In considering these studies, the different instruments used, the varying results, and the large difference in sample size prevent one from making any reasonable conclusions regarding the relation between locus of control and computer programming.

4.1.2.3. Summary of studies on locus of control, and computer attitude, experience, stress and performance

In summary, Morrow et al (1986) found that computer experience and locus of control were significantly related to computer anxiety with less experience and higher externality accompanied by higher levels of anxiety. However, computer experience explained more of the variance in computer anxiety than did locus of control, a finding which implied that computer

anxiety may be more a function of prior experience (an easier modifiable situation) than locus of control (a more deeply entrenched personality trait).

Furthermore, Coovert and Goldstein (1980) found that internals and externals have different attitudes towards computers, with internals having overall a more positive and less negative attitude towards computers than externals. In particular, it was found that those with positive attitudes towards computers showed higher internality than those with negative attitudes towards computers; and those with positive attitudes towards computers felt that 'powerful others' and 'chance' (dimensions of externality) were less controlling in their lives than those with negative attitudes towards computers.

In support of this, Wesley et al (1985) found that internals have more positive attitudes towards computers and better performance with computers than externals. He also showed that internals were more likely to have had previous computer experience than externals.

However, and contrary to the previous results, Woodrow (1990) found a more positive attitude towards computers among externals rather than internals. He also found no significant difference in previous computer experience between internals and externals. In particular, those who felt that academic success depends upon effort were negative in all their attitudes towards computers. And those who believed that luck influences academic achievement had generally positive attitudes towards computers. Also, among internals, those who felt that effort mainly determined academic success showed the most negative attitudes towards computers. On the other hand, only the belief that achievement success is ability driven generated the attitudes of computer confidence and liking but it did not reduce computer anxiety. Finally, Woodrow generally found locus of control to account for more variation in computer attitudes than computer experience.

4.1.3. Type A, and Stress and Computing

4.1.3.1. Type A and Stress

A personality construct, or as many of its investigators prefer to call it, behaviour pattern, frequently linked to stress is Type A. This psychological style, originally described as consisting of some combination of extreme competitiveness and achievement striving, a strong sense of time urgency and impatience, hostility and job involvement, explosive speech patterns and tenseness of facial muscles, was claimed to significantly increase a person's chances of suffering coronary heart disease (Rosenman, Friedman, and Straus, 1964). In considering subsequent relevant literature however (e.g. Kobasa, 1988; Friedman and Booth-Kewley,

1987), the Type A personality construct has been related to anger, depression, and especially to hostility.

Individuals with these characteristics have been described as 'Type A', as opposed to the more relaxed 'Type B', who have been regarded to have a low risk of coronary heart disease. It should be noted of course, that like locus of control, Type A/Type B comparisons (or A and B Typology) is not an either/or measurement, but rather a continuum between two contrasting personality types.

Once again Payne (Cooper & Payne 1988) gives a sound review of this literature from which much of the following is drawn.

Van Dijkhuizen and Reiche (1980) showed that the Type As reported more quantitative workload, more responsibility for people, and more use of skills. Type As also exhibited more psychological complaints, higher diastolic blood pressure, and higher self-esteem. In addition, the researchers found that the A/B typology did moderate the relationship between stress (viewed here as stressors) and strain. Similarly, Orpen (1982), in his study of 91 middle-managers, found that the Type As experienced greater stress and strain at work (in Cooper and Payne, 1988).

Caplan and Jones (1975) dealt with a real-life stressor: the temporary (23 days) shutdown of the main computer in a university. The subjects were 75 computer users. The researchers were able to investigate the moderating role of Type A on relationships between changes in selected variables over time. They found that the correlation between changes in subjective workload and changes in anxiety was significantly higher for the Type A than the Type B persons. And the relationship between changes in anxiety and heart rate was higher for the Type A than for the Type B persons.

Keenan and McBain (1979), in their study of 90 middle-managers, also used Type A as a moderator of the relationship between stress(ors) and strain. They found that the correlation between A typology and role ambiguity was significantly higher than the correlation between Type B and role ambiguity (in Cooper and Payne, 1988).

Generally, although it is difficult to determine the extent to which Type A moderates the relationship between stress(ors) and strain, the weight of the evidence appears to be that, for Type A persons, the relationship between reported stress and strain is stronger for both psychological and (some) physical strains. On the other hand, it seems that, for Type Bs, the relationships are either much weaker or close to zero (Cooper and Payne, 1988).

According to Kobasa (1988) "Most promising for the stress" (and/or anxiety) "researcher arguing for the value of a personality concern is the impressive amount of prospective longitudinal and laboratory data on the Type A construct and health. Also, relevant and

promising is the current work on the early life experiences and socialisation of individuals who show Type A pattern as adults (e.g. Matthews, 1982), and those studies seeking to link changes in Type A with organisational and sociocultural changes (e.g. Totman, 1979). Most troubling to the personality and stress researcher are the many unanswered questions about what Type A is, and what psychological processes underlie it".

4.1.3.2. Type A in computing

In the post-session subjective stress ratings of the previous chapter, high frequencies of 'agree' and 'strongly agree' responses were found for questions seven and eight, referring to frustration and anger respectively. In particular, question seven was 'I felt frustrated' and question 8 was 'I felt angry' (see also Ch. 3, Table 5). This result suggested that a hint of bias reflecting impatience could have been detected as a salient characteristic of the mood and the feelings of the subjects after computer interaction. This idea confirms the view that impatient people get irritated by slow responses of machines.

In addition, these behaviour patterns may influence how people perceive, perform, and evaluate tasks: Type As may adopt different personal performance criteria, exert different levels of effort, and report different subjective experiences than Type Bs. As discussed before, the Type A behaviour pattern is characterised by a habitual sense of time urgency, competitiveness, aggressiveness, hostility, and ever-increasing expectations of personal productivity, characteristics relatively absent in the Type B behaviour pattern (Chesney and Rosenman, 1983; Cooper et al, 1988). Also, Type As tend to work faster than Type Bs even when no time limits are imposed (Damos and Bloem, 1985), and when forced to slow their pace not only report boredom but show performance decrements as well (Glass, 1977). Finally, Type As tend to compete with (unrealistically high) self-imposed performance standards. For example, Damos and Bloem (1985) found that Type As were less satisfied with their performance than Type Bs, although they performed better.

Hart et al's study (1987) was designed to evaluate the effects of experimentally controlled variations in time pressure and computer task complexity on males classified as either Type A or Type B; the purpose of the study was to determine whether these behaviour patterns are, in fact, associated with differential responsiveness.

Four levels of supervisory - control task difficulty were selected from those used in an earlier study (Hart et al, 1984), to provide a suitable range of task demands. Hart et al (1987) hypothesised that Type As would exhibit momentary elevations in cardiovascular measures, in response to task-related stressors, while Type Bs would not. In addition, they anticipated that

Type As would report lower effort and fatigue, and would be more critical of their performance achievements than Type Bs. Finally, Hart et al (1987) thought that their study

"would identify the Type A / B behaviour patterns as salient sources of individual differences in subjective measures of computer workload, and could be used to predict how specific individuals might respond to different tasks".

The subjects, in Hart et al's study, were 31 males. Since three of them were classified as a mixture of Type A and B behaviour patterns, only the data from 14 Type As and 14 Type Bs were analysed.

A supervisory - control simulation consisted of computer task elements that had to be performed and control functions that subjects could invoke to perform the task elements. Several tasks could be completed in parallel or one could be finished before beginning the next. Various penalties were imposed when subjects delayed performing specific activities; they could also "shed" tasks if they were behind, or request additional tasks if they were ready to perform them ahead of schedule. Subjects selected tasks and control functions based on their assessment of the situation, task urgency and difficulty, and the reward or penalty for performing or failing to perform them respectively. The goal was to score as many points as possible up to a maximum of 500 (Hart et al, 1987).

Computer task complexity was determined by the number of elements per task (4 or 10), and time pressure was manipulated by varying element - movement rate. Trained operators could complete one group of task elements before the next was presented, but the mental and physical effort required to do so varied.

Four practice and four experimental sets of computer tasks (of different level of difficulty) were presented in a different order and for each subject. Subjects rated their experiences immediately after each set, using the NASA Bipolar Rating Scale (Hart et al, 1984), which consisted of nine workload-related subscales. The ratings for every set of tasks were averaged to produce a workload score that ranged from 0 to 100.

In addition a 10-15 minutes Type A Structured Interview was given by a trained interviewer (Chesney, Eagleston, and Rosenman, 1980). The interview provided a structured situation where the interviewer sought to create a sense of urgency, and provide an opportunity for subjects to compete with the interviewer or themselves through confrontations and challenges. The assessment represented a global subjective evaluation of the presence or absence of specific characteristics associated with the Type A behaviour pattern; according to this assessment subjects were rated as Type A, Type B, and mixture of Type A and B patterns (Hart et al, 1987).

In considering performance, it was found that scores improved significantly between practice and experimental sets of tasks. However, Type Bs improved less than Type As. Also, scores differed significantly among the four sets of tasks: the negative effects of complexity and time pressure were more apparent when more elements of tasks had to be performed to achieve the same score. Besides, Type As' scores were higher than Type Bs, although the difference was not significant.

In considering the workload subjective ratings, they were not significantly different between practice and experimental sessions, unlike the performance scores. It was also found that the complexity and time pressure had a greater impact on workload ratings than did the number of elements per task (i.e. the objective workload). Finally, there was no significant difference in workload ratings between Type As and Bs (Hart et al, 1987). Note here, that these results were similar to those in an earlier study by Hart et al (1984).

Hart et al's study suggests that the distinction between Type A and Type B behavioural characteristics can provide significant and useful information about a potential source of individual differences in computer workload experience and computer performance.

An additional important point, derived from Hart et al's study, is that although subjective ratings were found to be the most sensitive measure of computer workload, the evaluations given by the two groups (i.e. Type As and Type Bs) may not have been equally reflecting and representative of their experiences. In particular, Type A subjects evaluated (the quality of) their performance more stringently, and they appeared to be less sensitive to the effort they exerted to achieve their (higher) scores: their physical and mental effort subscale ratings were lower and they reported similar levels of fatigue, even though they appeared to have been working harder than Type Bs, according to the higher number of function-key actuations that they made. This suggested that the two groups were not equally accurate in evaluating computer task- and operator-related aspects of their experiences.

4.1.4. *Personality structure: Extraversion and Neuroticism*

4.1.4.1. General

The importance of describing the major patterns of behaviour in human subjects has always been recognised by psychologists, and the search for the main dimensions of personality has been pursued by several well-known figures.

Without doubt, the most sophisticated trait personality theory is that of H.J. Eysenck. The theory, which has spawned the Eysenck Personality Inventory (EPI), has been latterly revised.

This questionnaire has been subjected to extensive investigation and proved robust (Helmes, 1989).

The theory, which has undergone several changes over a thirty-year period, argues for the psychophysiological basis of personality, and locates two major factors which relate to social behaviour. In particular, a review of the literature by Eysenck (1960a) has disclosed strong support for a view which recognises the existence of two very clearly marked and outstandingly important dimensions; these have been called, respectively, Extraversion - Introversion, and Neuroticism, Emotionality, or Stability - Instability; it is an empirical fact that a large proportion of the total common variance produced by the observed correlations between many personality traits can be accounted for in terms of these two factors (Eysenck and Eysenck, 1964).

There is also general agreement that Dimension I of 'The five-factor model' (e.g. Goldberg, 1981; Hogan, 1983; Brand, 1984; Digman, 1988; and John, 1989) is Eysenck's (1947) Extraversion / Introversion and that Dimension IV of the same model represents the presence and effects of negative affect, or Tellegen's (1985) Negative Emotionality. To line up with the vast work of Eysenck over the years, dimension IV is usually referred to as Neuroticism vs Emotional Stability or Anxiety (McCrae and Costa, 1985, 1989). Here, then, are the original Eysenck "Big Two", first delineated over 40 years ago.

Thus, while not wishing to deny the existence and importance of factors additional to Extraversion (E) and Neuroticism (N), Eysenck and Eysenck (1964) suggested that these two factors contribute more to a description of personality than any other set of two factors outside the cognitive field.

Eysenck (1957) went beyond the merely statistical approach, and tried to link up personality dimensions with the main body of experimental and theoretical psychology. Such work, as has been done along these lines, has tended on the whole to support the view that the N factor is closely related to the inherited degree of lability of the autonomic nervous system, while the E factor is closely related to the degree of excitation and inhibition prevalent in the central nervous system (Eysenck, 1960a); also, this balance is presumably largely inherited, and may be mediated by the ascending reticular formation (Eysenck, 1963).

Following this line of thought, deductions have been made from general and experimental psychology regarding the expected behaviour of extraverted and introverted subjects on a great variety of laboratory experimental investigations. Relations have been discovered between extraversion and conditioning, level of aspiration, figural after-effects, masking, reminiscence, vigilance, sedation threshold, rotating spiral after-effects, constancy phenomena,

the occurrence of time error, verbal conditioning, time judgement, pain and sensory deprivation tolerance, and many others (Eysenck, 1960b).

Although the theory has been applied to a wide range of activities including criminality, sex, smoking, health, and learning, less work has been done on the Eysenck's dimensions correlates of occupational behaviour. However, over the last twenty-five years, there is evidence not only of the application of Eysenck's theory but also its predictive usefulness in the occupational sphere (Furnham, 1992, 1995).

4.1.4.2. Extraversion and Neuroticism in Computing

Four empirical studies have investigated whether extraversion contributes to predicting general computer programming achievement (Chin and Zecker, 1985; Kagan and Douthat, 1985; Kagan and Esquerro, 1984; Newsted, 1975). Kagan and Esquerro (1984) found that extraversion was negatively correlated with achievement on FORTRAN exams. However, Kagan and Douthat (1985) indicated that ability to master BASIC was unrelated to any of the personality traits assessed – including extraversion. Chin and Zecker (1985) found no significant correlation between extraversion and success in computer programming, but their study was limited to 32 college student volunteers. Newsted (1975) sent a survey to college students and assessed introversion/extraversion via one question. He did not find the dimension to be significant in predicting success.

In short, three of the four studies did not find extraversion related to computer programming. However, the large difference in sample size, the varying results, and the different instruments in some cases used prevent one from making any definite or reasonable conclusions regarding the relation between extraversion and computer programming achievement.

However, a small set of subsequent studies began to look at the relations between Eysenck's dimensional model of personality and computer-related attitudes. Egg and Meschke (1989) administered the German translation of the Eysenck Personality Inventory (EPI) to 63 fourteen to eighteen year old male adolescents in Germany. Katz and Offir (1991) administered the 90 item Eysenck Personality Questionnaire (EPQ) alongside a scale of attitude towards computers to 164 teachers in Israel. Katz (1993) administered the 48 item short form Revised Eysenck Personality Questionnaire (EPQ-R) together with a scale of attitude towards computers to 97 fourteen year old secondary school pupils in Israel. Katz and Francis (1995) administered the Hebrew version of the 90 item EPQ alongside a scale of attitude towards computers to 190 female trainee teachers in Israel. Sigurdsson (1991) administered the 90 item EPQ alongside a 33 item measure of computer-related attitudes to 149 first year psychology students at a Scottish University. Francis (1995) administered the 48 item short form EPQ-R together with a

set of instruments concerned with computer-related attitudes to 378 first year undergraduate students in Wales. As yet, however, there is no clear consensus among the findings from these studies. At the same time the theoretical bases from which relations between personality and computer-related attitudes may be hypothesised is not yet well developed.

Research suggests that a positive attitude towards computers is inversely related to computer anxiety (e.g. Gressard and Loyd, 1986), while specific anxieties tend to be related to trait anxiety and to the underlying personality dimension of neuroticism (Francis, 1993). These relations suggest a negative correlation between neuroticism and computer-related attitudes. Although this hypothesis is supported by the findings of Sigurdsson (1991), Katz and Offir (1991) and Katz (1993), it is not, however, supported by Egg and Meschke (1989), by Katz and Francis (1995), or by Francis (1995) except in relation to the specific construct of computer anxiety.

Research suggests that a positive attitude towards computers may reflect a preference for solitary activities and an avoidance of social interaction (Alspaugh, 1972), while extraversion is clearly characterised by sociability, a preference for group activities and an avoidance of solitary activities (Eysenck and Eysenck, 1975). These relations suggest a negative correlation between extraversion scores and computer-related attitudes. This is consistent with Bozeman's (1978) findings which reported some degree of relation between extraversion and apprehension of computer technology, and with Katz and Offir's (1991) findings. On the other hand, Egg and Meschke (1989), Sigurdsson (1991), Katz and Francis (1995), Francis (1995), and Katz (1993) found neither a positive nor a negative relation between extraversion and attitude towards computers.

Subsequently, Francis, Katz, and Evans (1996) explored the relations between computer-related attitudes and the Eysenckian personality dimensions of extraversion and neuroticism. In their study, a sample of 298 female undergraduate students in Israel completed the Hebrew version of the short form Revised Eysenck Personality Questionnaire (EPQ-R) (Montag, 1985), together with a new Hebrew translation of the Attitude Towards Computers Scale as developed by Reece and Gable (1982) and modified by Marshall and Bannon (1986). The project was undertaken within the context of the introductory psychology course within the first year of a teacher education programme.

The results demonstrated that more positive attitudes towards computers were associated with lower scores on the extraversion scale, and, thus, introverts were found to have a more positive attitude towards computers than extraverts. However, no significant relation was found between (scores on) attitudes towards computers and (scores on) the neuroticism scale.

Two main conclusions emerge from Francis et al's (1996) results:

First, the significant negative correlation between extraversion scores and attitude towards computers lends support to the hypothesis that a more positive attitude towards computers may be positively related to a more general tendency to prefer solitary activity and to avoid social activities. This conclusion was also supported by Katz and Offir (1991), although not by Sigurdsson (1991), Katz (1993), Katz and Francis (1995) and Francis (1995).

Second, the absence of a significant correlation between neuroticism scores and attitude towards computers does not support the hypothesis that a more positive attitude towards computers is inversely related to neuroticism or anxiety. This conclusion was also supported by Katz and Francis (1995) and by Francis (1995), while Sigurdsson (1991), Katz and Offir (1991) and Katz (1993) found a significant negative relation between neuroticism and computer-related attitudes.

It seems that further studies are needed using other indices of computer-related attitudes and conducted among other samples in order to clarify the conditions under which the two hypotheses linking personality and computer-related attitudes hold good and the conditions under which they do not hold good.

Furthermore, it appears that there is virtually no relevant research on the effects of extraversion and neuroticism on computer stress, and performance. Thus, in addition to computer-related attitudes, there is certainly a prospect for research into this area - studies which investigate computer attitude, computer stress as well as computer performance and experience in relation to the previously considered personality variables. This can be done by correlating the above 'computer' variables with personality variables and also by calculating the contribution of personality variables to the variance of computer stress and performance over and above initial computer attitudes; and this is the orientation of this chapter.

4.1.5. Conclusion, research questions and aims of the study

One of the problems in interpreting the discrepant findings from previous research concerns the variety of instruments employed to assess some of the variables, such as computer-related attitudes and locus of control.

In considering attitudes as an example, the few empirical studies which have attempted to evaluate the relation between different measures of computer-related attitudes suggest that there is some variation within the constructs being measured (e.g. Woodrow, 1991; Gardner, Discenza and Dukes, 1993; Francis, 1995). It is reasonable to expect that some aspects of computer-related attitudes will relate to personality variables in ways different from other aspects of computer-related attitudes. Thus, Francis (1995), for example, demonstrated a

significant relation between neuroticism and computer anxiety, but not between neuroticism and general positive attitude towards computers.

The aim of the present study, therefore, is to further the debate regarding the relation between personality and computer-related attitudes:

A) By having selected an attitudes' instrument which clearly reflects three recognised uni-dimensional views of attitude towards computers and which also functions as an index of computer anxiety. As seen in previous chapters, the main instrument selected was the Computer Attitude Scale (CAS) developed by Loyd and Gressard (1984); this, as described in chapter two, is a popular, well-established and standardised measure assessing three widely recognised views of computer attitude: computer anxiety, confidence, and liking. Durham Computer Attitude Scale have also been selected as an additional index of general computer attitude assessing predominantly computer liking. The items of both measures combine the cognitive, behavioural and affective attitudinal domains (Loyd and Gressard, 1984, 1986, 1987; Crook, 1986).

B) By selecting two locus of control instruments: a) Levenson's locus of control (1974) scale, as described in the 'Method' section of this chapter, clearly reflects three recognised views of locus of control (Internal, Powerful Others, and Luck), as derived from the popular, well-established and standardised Rotter's (1966) Internal-External (I-E) scale. Levenson has improved the I-E scale mainly by differentiating between externals who attribute control to 'chance' and externals who attribute control to 'powerful others' (for more details see the 'Method' section). b) Paulus' Spheres of Control (SOC) inventory (1989) is a more recent established and standardised locus of control measure, which appears to be complementary to Rotter's and Levenson's scales. It reflects three views of locus of control (Personal, Interpersonal, and Socio-political) by subdividing Rotter's internality rather than externality (for more details see the 'Method' section). Thus, Levenson's scale appears to distinguish dimensions, whereas Paulus' scale appears to distinguish domains. It is noteworthy here that, in general, the locus of control construct entails a family of measures that may include different dimensions, domains, or both. Often, different dimensions or domains do not particularly correlate; and different locus of control scales can give different results (Furnham, 1987).

C) In considering the Type A construct, the Occupational Stress Indicator (OSI; Cooper et al, 1988) was used. There is some evidence (e.g. Kline, 1993) that the OSI may not contain particularly reliable or valid measures, and it may be more applicable as a practical tool used in organisations than a research tool. However, many of the OSI's items are useful for addressing the issues of impatience and speed ('speed' was suspected to relate to computer stress), rather than the hostility and aggression issues mainly relevant with coronary heart disease.

Furthermore, Type A measures are not very common in the relevant literature and a large number of studies related to the Type A construct have measured it by conducting structured or semi-structured interviews with the subjects. The Jenkins Activity Survey (Jenkins, Zyzanski, and Rosenman, 1979) was also considered for the present research. However, it was not adopted since, among other disadvantages, it seems to be difficult to score and time consuming, and emphasises mostly the issue of 'arousal' – not of any particular interest within the present research. Moreover, the Jenkins Activity Survey is long, and it was thought that something brief would be more suitable for the present research (OSI's Type A subscale has only 14 items). [For details on the OSI see the relevant 'Method' sub-section].

D) Finally, in considering Extraversion and Neuroticism, the EPI has an excellent record of validity and reliability; it has also been very popular, since it was selected by almost all of the previous research in personality and computer-related attitudes.

Aims of the study

The personality constructs of locus of control, extraversion, neuroticism and the type A behaviour pattern were considered. In the light of the previously discussed literature the main aims of this study were guided in terms of the following research questions:

I. Locus of control

1. Do dimensions of locus of control relate to computer attitudes, including computer anxiety?
Is it an internal or an external perception of control that positively correlates with (initial) computer attitudes?

While Coovert and Goldstein (1980) as well as Wesley et al (1985) found that internals have a more positive and less negative attitude towards computers than externals, according to Woodrow's results (1990) there is a more positive attitude towards computers among externals rather than internals.

Morrow et al (1986) found that higher externality of locus of control was significantly related to higher computer anxiety; however, Woodrow's (1990) findings either failed to support or else contradicted these results.

In addition, while Morrow et al found computer experience to be a better predictor of computer anxiety (regarded as part of computer attitudes) than locus of control, Woodrow generally found locus of control to account for more variation in computer attitudes than computer experience.

2. Do dimensions of locus of control relate to stress before and after computer sessions? If so, is it an internal or an external perception of control that correlates positively with computer stress?
3. Does locus of control relate to performance and subjective difficulty in computing tasks? If so, is it an internal or an external perception of control that correlates positively with performance and subjective difficulty?

Wesley et al (1985) found that internals achieve better performance on various computer tasks than externals; however, Woodrow's (1990) findings either failed to support or else contradicted these results.

II. Type A

In general, do type A subjects have more positive attitudes towards, less stress about, and better performance with computers (e.g. Hart et al, 1987)? On the other hand though, it might be thought that the impatience aspect of type A might affect attitudes, stress, and performance negatively.

In particular:

1. Do dimensions of Type A-B personality construct (or behaviour pattern) relate to attitudes (including anxiety) towards computers?
2. Do dimensions of A-B Typology relate to stress before and after computer sessions?
3. Does A Typology relate to (a) performance and (b) subjective difficulty in computing tasks?

III. Neuroticism or Instability

There are three steps in the following argument: 1) the relationship between 'trait anxiety' and 'neuroticism' is so close and their correlation is so high that some researchers treat them as terms describing the same or at least similar concepts (e.g. Cattell and Scheier, 1958); 2) computer anxiety may be seen as a 'state' and neurotic type of anxiety (see General Introduction); and 3) a greater proportion of high trait anxiety individuals experience higher levels of state anxiety, in both intensity and frequency (Spielberger, 1970, 1972). Therefore, it can be argued that Spielberger's theory may also 'predict' that a greater proportion of high neuroticism individuals will experience higher levels of computer anxiety when thinking about and/or using computers. Thus, in this context, an individual's computer anxiety, stress, attitudes (perhaps also the respective performance) and their changes may depend, at least in part, upon his/her level of neuroticism.

The rationale here is that an individual with a high level of neuroticism (or trait anxiety) can be expected to be more vulnerable not only to specific types of anxiety, such as computer anxiety, but also to negative attitudes towards computers. In fact, Raub (1981) found trait anxiety to be a significant correlate of computer anxiety and attitudes towards computers, and Howard (1986) found trait anxiety to be a significant correlate of attitudes towards computers.

The question raised within the present study, which may need further consideration, is: what is the relationship between computer anxiety, attitudes, stress (perhaps even related performance), and neuroticism?

In particular:

1. Does neuroticism (instability) relate to attitudes (including anxiety) towards computers?
2. Does neuroticism relate to stress before and after computer sessions?
3. Does neuroticism relate to performance and subjective difficulty in computing tasks?

IV. Extraversion

As mentioned before, it appears that there is only some limited and contradictory research on extraversion in relation to computer-related attitudes; and there is virtually no relevant research on extraversion and any other of the computing variables. However, extraverted students were generally found to choose people-oriented courses whereas introverted students preferred more theoretical subjects and had greater examination success than extraverts in the physical sciences (Wankowski, 1973). In addition, introverted students were less dissatisfied and achieved better performance on a simulated non-stimulating work task than extraverts (Kim, 1980). Also, extraverted workers found it more difficult than introverts to maintain work performance over time (Furnham, 1992, 1995) or driving performance over a four-hour period (Fagerstrom and Lisper, 1977).

In considering at least the general research reported here, as well as the particular characteristics of extraverts and introverts, the question raised within the present study, which needs further consideration, is: what is the relationship between computer attitudes, stress, performance, and extraversion? In general, do introverted subjects have more positive attitudes towards, less stress about, and better performance with computers? At an ultimate level, it might be speculated that the quiet, reserved, tidy-minded, well ordered, and well organised personality characteristics of the introverts might affect positively their computer attitudes, stress and performance, since computers may be perceived by the introverts as compatible to these characteristics.

Thus, in the light of the previously discussed literature, the particular main aims of this study were guided in terms of the following research questions:

1. Does extraversion relate to attitudes towards computers?
2. Does extraversion relate to stress before and after computer sessions?
3. Does extraversion relate to performance and subjective difficulty in computing tasks?

V. General

It was shown from the multiple regressions results in chapter three, that (initial) computer attitude, and in particular computer confidence, as measured by CAS, may be considered as: (a) a worthwhile predictor of stress (as measured by SACL) experienced after computer interaction, and accounting for 11% of the variance in 'stress after'; (b) a strong predictor of stress, anger, frustration, etc, (as measured by the subjective ratings, CPTOT), experienced after computer interaction, and accounting for 31% of the variance in CPTOT; (c) a weak predictor of performance in completing computer tasks (accounting for 2% of its variance); and (d) a moderately strong predictor of subjective difficulty experienced when completing computer tasks (accounting for 21% of its variance).

Similarly, computer attitude, as measured by DCAS, was shown to considerably predict stress experienced before computer interaction (accounting for 12% of its variance), stress experienced after computer interaction (accounting for 9% of its variance), CPTOT (25%), performance (3%), and subjective difficulty (17%).

In addition, as previously discussed, some personality characteristics may be considered significant modifiers of response to (computer) stress, since they may significantly render the person more, or less, susceptible to stress. This possible function of personality characteristics may be applicable not only for stress but also for (computer) performance and/or subjective difficulty.

Thus, the general and final question raised within the present chapter is:

Does information on personality variables (i.e. locus of control, type A, extraversion, and neuroticism) add or contribute anything to the variance of computer stress and performance, over and above initial computer attitudes?

4.2. Method

4.2.1 Subjects

As before, the subjects of this study were Psychology Undergraduates at the University of Durham and taking the required psychology practical sessions which have a computing component. This included introductory and advanced information and practice on the respective University Computer Operating System [MTS (Michigan Terminal System) in academic years 90-91 and 91-92, and UNIX in academic year 92-93]. It also contained basic and further (advanced) information and practice on a Screen Editor (CURLEW) and an electronic mail utility (EMU).

None of the subjects had studied Psychology previously at University, and most were in their first year of study.

The subjects were the first year psychology class of Durham University for three subsequent academic years, consisting of:

- i. Academic year 1990-91 - 99 individuals, 44 males and 55 females;
- ii. Academic year 1991-92 - 106 individuals, 47 males and 59 females;
- iii. Academic year 1992-93 - 119 individuals, 52 males, 58 females, and 6 unknown (missing data).

In total, the number of subjects participating in all studies was 324 (143 males, 172 females, and 6 unknown).

4.2.2 Materials and measures

4.2.2.1 Levenson's locus of control scale

Rotter's (1966) Internal-External (I-E) scale measures the extent to which people believe they exercise control over their lives (internally controlled) or the degree they feel their destinies are beyond their own control and are determined by fate, chance, or powerful others (externally controlled). However, several researchers (Gurin et al, 1969; Lao, 1970; Mirels, 1970, etc) presented empirical evidence indicating that Rotter's I-E scale is not uni-dimensional, but could be separated into various factors: felt mastery over an individual's own personal life, expectancies of control over political institutions, and an individual's beliefs about the role of internal and external forces in the society in general. Reviews of locus of control research (e.g. Joe, 1971; Lefcourt, 1972) suggested that to be a valid instrument, Rotter's I-E scale (1966) should undergo further refinements. In Levenson's view (1974),

refinements should aim to explain some of the inconsistencies found in the relevant research literature relating locus of control expectations to behaviour.

Despite the fact that, even in 1971, over 150 studies were published dealing with Rotter's I-E construct (Throop and MacDonald, 1971), reported results regarding an individual's locus of control and certain important behaviour variables had been conflicting. For example, Gore and Rotter (1963) and Strickland (1965) found that black youths who engaged in social protest action held more internal control expectancies than their less active black peers. However, results from other studies (e.g. Gurin et al, 1969; Ransford, 1968, etc) indicated that black youths who were willing to participate in protest behaviour scored the lowest in internal control.

Levenson (1974) attempted to revise Rotter's I-E scale in order both to investigate / clarify the relationship between an individual's expectancies for control, and to obtain a conceptually cleaner instrument than the I-E scale. Thus, she hypothesised that the main problem with the I-E scale was that it did not differentiate between externals with expectancies that fate, chance, and destiny will control events, and externals with expectancies that powerful others will control events. Therefore, Levenson (1974) constructed three new scales (Internal, Powerful Others, and Chance - I, P, C) in order to measure 'chance' expectancies as separate from 'powerful others' expectancies. In general, the three scales were constructed to measure perceived mastery over an individual's life (I), expectancy for control by powerful others (P), and belief in chance (C) (see Appendix eight).

The rationale behind this three-part differentiation was that people who believe that the world is unordered (chance) would think and behave differently from people who believe that the world is ordered but powerful others are in control; in the latter case there is still a potential for control. Furthermore, a person who believes that chance is in control would be cognitively and behaviourally different from a person who feels that he/she himself/herself is not in control (low I scale scorer) (Levenson, 1974).

Each of the Internal (I), Powerful Others (P), and Chance (C) (sub)scales consists of eight items in a Likert format (possible range on each scale, 0 to 56). These are normally presented to the subjects as a unified (attitude) scale of 24 items. The scales are comprised of several items adapted from Rotter's I-E scale, and a set of statements written specifically for the new scales.

The three scales are statistically independent of one another, and the items on the I, P, and C scales differ from Rotter's I-E scale in two important ways: a) Instead of a forced-choice format, a Likert 7-point scale was used. b) On the I, P, and C scales a personal ('ideological') distinction has been made: All the statements are phrased so as to pertain only to the subject himself/herself. They measure the degree to which an individual

feels that himself/herself, powerful others, and chance have control over what happens to him/her, and not what he/she feels is the case for "people in general" (Rotter, 1966; Levenson, 1974).

Item analyses with several pre-test groups indicated that all of the items significantly distinguished between high and low scorers for each of the three scales. Correlations between the Marlowe-Crowne Social Desirability Scale (1964) and each of the items were all very near 0.00, the highest being only +0.19 (Levenson, 1974).

The correlations of each item to its total scale score are fairly high and consistent. However, internal consistency estimates are only moderately high, but since the items sample from a variety of situations, this is expected. These correlations compare favourably with those obtained by Rotter (1966) for the I-E scale. Kuder-Richardson reliabilities (coefficient alpha) yielded $\alpha=0.64$ for the I scale, 0.77 for the P scale, and 0.78 for the C scale. Split-half reliabilities (Spearman-Brown) were: $\alpha=0.62$ (I scale), 0.66 (P scale), and 0.64 (C scale). Test-retest reliabilities, for a period of one week, were: $\alpha=0.64$, 0.74, and 0.78, respectively.

4.2.2.2 Spheres of control (SOC) inventory

The most recent (1989) version of Paulhus and Christie's (1981), Paulhus' (1983), and Paulhus and Van Selst's (1989) Spheres of Control (SOC) Inventory was used (see appendix nine). This is a Likert-type instrument, consisting of 30 items, which present statements of personal, interpersonal, and socio-political locus of control. Hence, the instrument provides for scores on three subscales respectively: Personal Control subscale, Interpersonal Control subscale, and Socio-political Control subscale.

The approach is based on an a priori scheme, the Spheres of Control (SOC) model, reviewed by Paulhus and Christie (1981), Paulhus (1983), and Paulhus and Van Selst (1989). The conceptual system entails partitioning the individual's life space in terms of primary behavioural spheres. First, the individual vies for control within the non-social environment in situations of personal achievement; for example, climbing mountains, etc. Perceived control in this sphere was termed by Paulhus and Christie (1981) and Paulhus (1983) as 'personal control', 'personal efficacy', or 'achievement'.

Second, the individual interacts with others in dyads and group situations; for example, attempting to develop social relationships, etc. In this sphere, the appropriate label given by the authors was 'interpersonal control' (i.e. control over other people). Third, the individual's goals often conflict with those of the political and social system; for example, taking part in a demonstration, etc. Perceived control in this sphere was termed by Paulhus and Christie as 'sociopolitical control' (i.e. control over social and political events and institutions).

The conceptual model underlying the three scales composing the SOC Inventory holds that personal efficacy, interpersonal control, and socio-political control are conceptually independent dispositions. It follows that an individual may have quite different expectancies of control in his/her three domains of interaction with the world [Paulhus (1983) thought that empirically the three expectancies should correlate moderately].

Therefore, assessment of perceived control with a single measure (e.g. Rotter's Internal-External Locus of Control Scale) might not characterise the individual adequately, and could conceivably be a misleading indicator of perceived control in a specific setting. Rather, the individual should be characterised by a 'control profile', a pattern of expectancies that he/she brings into play in confronting the world (Paulhus, 1983).

Note, that this approach dispenses with a number of other dimensions that may overlap with the three SOC factors; for example, Chance, Powerful Others (Levenson, 1974), Difficult World, Just-World (Rotter, 1966), etc. According to Paulhus (1983), SOC model is not contradictory to other differentiations of sources of control (e.g. Levenson's) but rather complementary to them. Hence, both Paulhus' and Levenson's conceptual models of locus of control (underlying the respective measures) were used within the present study.

In summary, the spheres of control approach to assessing perceived control has three major characteristics: a) it entails a systematic partitioning of the individual's control expectancy in terms of three major spheres of activity; b) it provides an instrument to assess interpersonal control, an area that has been relatively neglected; and c) as opposed to Levenson's model, it subdivides internality rather than the external forces to provide a set of attributes for characterising individuals.

More specifically, the SOC subscales were constructed and refined over a period of two years in a series of five psychometric studies. The details of the scale development were described in a review by Paulhus and Christie (1981). Other details concerning the scale development and validation were provided in Paulhus (1983). SOC consists of ten items for each of the three subscales (in total, it is a 30-item questionnaire). Typical alpha reliabilities ranged between 0.75 and 0.80 on cross-validation samples; these were actually higher than the range 0.65 to 0.70 values obtained for Rotter's scale on the same samples (Paulhus and Christie, 1981). Test-retest correlations at four weeks were above 0.90, and at six months were above 0.70 for all three subscales (Paulhus, 1983).

In addition, Paulhus (1983) tested a three-factor structural model using confirmatory factor analysis, and the results showed the scales to have impressive convergent and discriminant validity in relation to other individual difference measures. Also, three validity studies related

to sporting, socio-political and interpersonal behaviour provided good supporting evidence for the efficacy of the scale.

The number of positive and negative items is balanced for each subscale. Each item is rated on an 1-7 point agree-disagree (or: applies to me - doesn't apply to me) Likert scale. The values for negative items are reversed. The scores are summated for each subscale.

The range of scores is from 10 to 70 for each of the subscales. Although the three subscales can be looked at separately, a total locus of control score can also be taken, which is sometimes thought to be a more stable predictor. Thus, the minimum of the total score is 30, whereas the maximum 210.

The advantages of the final SOC Inventory are quite evident. The 30-item Likert-format inventory takes much less time to complete than the original 29-item Rotter's scale, mainly because the latter's forced-choice format requires the comprehension of twice as many statements.

4.2.2.3 The O.S.I. (Occupational Stress Indicator)

A subscale of Cary L Cooper's, Stephen Sloan's, and Stephen Williams' Occupational Stress Indicator (O.S.I., 1988) was used. This is a Likert-type instrument, consisting of six questionnaires. These questionnaires are designed to measure both the sources and effects of occupational stress. Each of these questionnaires is also consisted of a varied number of questions and is divided into a series of subscales which measure different dimensions of stress.

The OSI subscale 'The way you behave generally' was used for this study (see appendix eleven). This is a Likert-type instrument, consisting of 14 items, which present statements of the 'Type A syndrome'. The instrument provides for scores on three subscales respectively: attitude to living subscale, style of behaviour subscale, and ambition subscale.

Type A syndrome can be considered as an overall style or manner of behaviour that is characterised by excessive time consciousness, abruptness of speech and gesture, competitiveness, etc. Cooper et al (1988) noted that ironically these stress prone behaviours are the very behaviours that are rewarded in our western industrial society; particularly in males, they portray the stereotype of the dynamic executive.

The (sub)instrument used in this study, consists of fourteen statements which the respondent must rate separated into three subscales measuring different crucial aspects of the Type A personality. These are:

- a) Attitude to living: This subscale measures the underlying perspective that individuals have regarding their lives and work. It measures the basic components concerning confidence,

commitment, etc, as well as addressing work priorities and degree of dedication. The subscale represents how individuals cognitively construe such issues.

- b) **Style of behaviour:** Whilst the first subscale measured the cognitive component of Type A behaviour, this subscale measures the behavioural component, i.e. what individuals actually do. The underlying issues that run through the items are speed and abruptness of behaviour.
- c) **Ambition:** This subscale could well be included as part of the previous two. However, its emergence and inclusion in the O.S.I. show that high need for achievement is manifest in both attitude to living and style of behaviour and is a separate quality in its own right (Cooper et al, 1988).

The details concerning the Type A subscale and issues of validity and reliability were provided within the O.S.I. Management Guide. In particular, the subscale consists of six items for the 'Attitude to living' dimension, five items for the 'Style of behaviour' dimension, and three items for the 'Ambition' dimension (in total, the subscale is a 14-item questionnaire).

The number of positive and negative items is balanced for each subscale. Each item is rated on a 1-6 point agree-disagree Likert scale. The values for negative items are reversed. The scores are summated for each subscale.

The range of the scores is from 6 to 36 for the 'Attitude to living' dimension, 5 to 30 for the 'Style of behaviour' dimension, and 3 to 18 for the 'Ambition' dimension. Although the three subscales can be looked at separately, a total Type A score can be taken which may provide a better measurement because of the increased number of items involved. The minimum of the total score is 14 and the maximum 84. In addition, a 'Broad view of Type A' score can be derived from six of the strongest items of the subscale and can be considered as a quick summary assessment representing the total Type A subscale score. All four dimensions (Attitude to living, Style of behaviour, Ambition, Broad view of Type A), as well as a total Type A score (defined as the sum of the subscores on Attitude, Style, and Ambition) were used in this study.

Cooper et al (1988) performed an analysis in order to confirm the performance claimed for the OSI. In particular, they investigated three different aspects of the instrument: content validity, construct validity, and empirical validity:

- a) In general, two aspects of content validity may be considered. The first, face validity, was measured by Cooper et al (1988) in the pilot work conducted for the development and application of the OSI. This concerned the subjective comments which respondents were explicitly requested to insert about the different sections, wording of questions and answers, layout, subjects covered and so on. These were incorporated into later versions of the

Indicator. Apart from specific issues, according to Cooper et al (1988), general feedback was positive. In the authors' view, there was no evidence to suggest that the OSI questionnaires appeared inappropriate.

The second aspect of content validity is that of factorial validity. Cooper et al (1988) conducted factor analysis within each section of the OSI. However, an analysis across the whole width of the 'Indicator' was not performed because the authors thought it was unnecessary "since the previous research indicated the different sections to be independent in terms of what they were measuring". The method of factor analysis used was PA2 with iteration, oblique rotation with default Delta SPSSX (SPSS INC. 1983)" (Cooper et al, 1988).

b) In considering construct validity, Cooper's model of stress has been used as a basis for design of the OSI questionnaires. In addition, Cooper et al stated that the OSI did not intend to tap all aspects of stress but aimed to examine some, only. They also reminded that the OSI is not really a psychological test but an 'indicator' for use by individuals in industry who may have no psychological or statistical knowledge.

c) In considering empirical validity, Cooper et al's plan was to test this kind of validity in the 'normal way', i.e. by examining the relationship of the OSI with other measures of the same variables. However, according to the authors, in the context of establishing empirical validity, methodological issues of occupational stress may be the most crucial factors.

Two main aspects of reliability were considered by the authors. The first, test-retest reliability, had been the subject of ongoing investigation (Cooper et al, 1988). The other reliability concerned internal consistency of the OSI subscales uncovered by the factor analysis previously mentioned and the subscale construction process. In determining reliability in this sense the split half coefficient was used by the authors. All coefficients were significant at 0.01 level or much better (in many cases 0.001), in a sample of the size N=156. However, as Kline (1993) points out, all of the Type A scales have split half reliabilities below 0.45, so results should be interpreted with caution.

Cooper et al (1988) also reported that although, generally, coefficients were of satisfactory magnitude, the measures of Type A behaviour and especially the measures of control yielded low (and in the case of Control) non significant coefficients. The authors thought that the measures of Type A behaviour and Control should emerge in this way. They also thought that there are a number of reasons for these particular findings. Among the most important ones, first, Type A and Control personality traits are difficult characteristics to assess by their very nature, and second, they represent very general dispositions towards a potentially limitless range of situations (Cooper et al, 1988).

Thus, although there is generally a problem with the measurement of Type A personality construct, in this study the subscale of OSI was chosen to tap impatience, hostility, aggression and vulnerability to stress and anxiety. In addition, although not a lot of reliance was placed on OSI's Type A measuring subscale, there were certainly advantages of using it, such as in reflecting subjects' personality characteristics as previously mentioned and in taking no more than five minutes to be completed.

4.2.2.4 The E.P.I. (Eysenck Personality Inventory)

Scale A of the EPI (Eysenck Personality Inventory) was used (see appendix ten). This measure has evolved to the EPQ (Eysenck's Personality Questionnaire), and EPI is now regarded as an old instrument. However, it is shorter than the EPQ which was regarded as an advantage in the present study. The short form of the EPQ (EPQ-R, 1991) was not available at the time of running the study.

The Eysenck Personality Inventory (E.P.I.) was a development of the Maudsley Personality Inventory (M.P.I. - Eysenck, 1959a; Knapp, 1962). Like the parent instrument, it sets out to measure two major dimensions of personality, extraversion and neuroticism (EPQ also measures psychoticism).

Similarly to EPQ, EPI is a yes/no response type of instrument, consisting of 57 items, which present statements of extraversion as opposed to introversion, neuroticism or instability as opposed to stability, and defensive responding or social desirability as opposed to non-defensive responding. Hence, the instrument provides for scores on three subscales respectively: extraversion subscale, neuroticism subscale, and lie subscale.

The range of scores is from 0 to 24 for extraversion, 0 to 24 for neuroticism, and 0 to 9 for the lie scale. The three subscales should be looked at separately, and no total score may be obtained.

The advantages of the EPI are quite evident, since the data (see introduction) suggests that the instrument is a reliable means of measuring extraversion and neuroticism. The consideration of extraversion and neuroticism as two important separate personality traits is a logical proposition with high construct validity.

4.2.3. Procedure

Three 3 hour practical sessions were held each week (on Thursday, Monday, and Tuesday) at the beginning of each of the three academic years of data collection, and students/subjects were required to regularly attend one of them. The computing practicals were

held for four weeks in academic year 90-91, for three weeks in academic year 91-92, and for four weeks again in academic year 92-93. The four personality questionnaires took place at the beginning of each academic year.

Subjects were administered the OSI Type A subscale, and the EPI, and at the beginning of their second Practical session, and Levenson's and Paulhus' locus of control questionnaires at the beginning of their third Practical session, both times together with an instruction sheet to remind them briefly about the study being conducted (see appendix 12) (they already knew about the survey from the previously administered instruction sheet on the two attitude scales and mood checklists).

In both cases, this sheet informed students that this was the follow up to the survey and we were asking them at this stage to complete this final set of questionnaires in the order they preferred.

As before, students were given the option either to use their codenames (same as entered on attitude questionnaires and mood checklists) or their MTS/UNIX identifiers/usernames or even their first names and surnames, providing that it was the same codename that they had used and would use on all previous and later occasions respectively, so that their responses could be compared to those taken both earlier and later in the academic year. At this point they were also reassured that all the information they give would be entirely confidential, would not be included in any records, and would be used only for research purposes.

Furthermore, subjects were advised to follow the instructions printed on each particular measure, to read each of the items carefully and try to respond as quickly and accurately as they could, remembering that there were no right or wrong answers and that their first reactions are usually the most reliable; therefore, they were advised not to spend too long considering each item. Finally, subjects were asked to make sure that they had answered every item required on each questionnaire.

In addition, a brief introduction was given orally, explaining that the questionnaires formed another part of a PhD research, outlining the nature of the investigation and what they had to do. The subjects were then given time to complete the questionnaires, after which they were collected individually, and briefly checked to ensure that there was no missing data. In this event, the subject was asked to complete the missed item. In all cases the researcher remained present during distribution, completion and return of the questionnaires, answering questions and helping subjects, when required, to appropriately complete the measures.

As a reminder the computing experience consisted of: within the academic year 90-91, the first week's practical was an introduction to the use of computer terminals, some general

information about the University - MTS Computer Operating System, and an introduction to the CURLEW Screen Editor as well as exercises to practise with the editor. The second week's practical included an introduction and practice with electronic mail (i.e. EMU - Electronic Mail Utility). The third week's comprised further information on MTS and practice with MTS commands and electronic mail, introduction to Curlew Block Mode and printing. Finally, the last week involved further information on MTS and more practice with MTS commands, advanced Curlew screen editor (including block mode), advanced electronic mail, printing and paging commands and printing facilities.

Similarly, in the academic year 91-92, the first week's practical was again an introduction to MTS and CURLEW. While the second practical included information and practice on EMU, the third one was about advanced MTS (further commands), Curlew 'Block' Mode, and printing.

At the beginning of the academic year 1992-93, the Durham University computer operating system changed from MTS to UNIX. The first week of practicals contained an introduction to UNIX, and to the CURLEW screen editor. The second week involved information on and practice with EMU within UNIX. The third practical contained further information about UNIX, more practice with UNIX commands as well as electronic mail, introduction to Curlew block mode and printing. The fourth week involved information and exercises on UNIX commands, advanced CURLEW screen editor (including block mode), advanced use of EMU, and printing commands and facilities.

Subjects were firstly taught in a Psychology Department lecture room about mainframe computing and computer facilities in the University in general, and in the Psychology department in particular. Afterwards each set of students (approximately the one third of the class) was further divided into two sub-groups. The first sub-group remained in the lecture room while the second moved to the Psychology Department computer room for actual computer operation - practice and application of what they had been taught during the preceding lecture. After finishing computing, the second group returned to the lecture room and then the first group moved to the computer room for their terminal session.

4.3. Results

As before, because analysis of residuals indicated that performance needed transformation (for example, the distribution of performance scores was found to be highly skewed and produced problems for regression analysis), an ARCSINE transform was used to stabilise the variance (and improve the distribution). Also, in order to stabilise the variance, the variable

SUBJ was firstly reflected and then a log transform was performed (hence the SUBJLOG). (Note that because of the transform, the sign goes in the opposite direction).

Table 4.1 summarises the descriptive statistics for all personality, attitude, stress, performance and subjective difficulty variables scores involved in this chapter. The values were obtained from the sample of 342 participating students. The table also shows the range of possible numerical scores (PNS) for the variables.

Test	Variable	PNS	Mean	St Dev	Min	Max	N
Levenson	INT	7 to 56	32.43	9.48	11.00	55.00	291
LOC	CH	7 to 56	35.23	6.75	12.00	53.00	291
	PO	7 to 56	29.76	8.02	12.00	51.00	290
Paulhus	PERS	10 to 70	30.40	6.33	15.00	48.00	261
SOC	INTPERS	10 to 70	30.22	7.74	13.00	51.00	261
	SOCPOL	10 to 70	38.60	6.58	19.00	67.00	261
EPI	EXTVER	0 to 24	13.59	4.49	.00	24.00	297
	INSTAB	0 to 24	11.47	4.96	.00	22.00	297
Type A	BRVIEW	6 to 36	22.62	4.16	12.00	55.00	298
	STY	5 to 30	17.20	3.34	8.00	26.00	298
	OSITOT	14 to 84	48.47	6.58	27.00	69.00	298
CAS	CANX1	10 to 70	46.69	12.63	15.00	70.00	320
	CCON1	10 to 70	45.13	11.35	11.00	70.00	320
	CLIK1	10 to 70	42.46	11.05	14.00	69.00	320
DCAS	DCAS1	20 to 100	64.16	12.29	23.00	97.00	320
Cox	STRBEF	0 to 18	5.26	3.82	.00	17.00	329
	STRAFT	0 to 18	5.61	3.97	.00	16.00	328
Subjective Ratings	CPTOT	5 to 20	13.64	3.33	6.33	21.33	226
(Log) Subjective Difficulty ¹	SUBJLOG		.62	.34	-.03	1.61	336
(Arcsine) Performance ²	ARCSPERF		1.14	.32	.29	1.57	336

¹ Subjective Difficulty range of numerical scores is from 1 to 5. Log transform used

² Performance range of numerical scores is from 0 to 1. Arcsine transform used.

The Levenson Locus of Control Questionnaire has three subscales: Internal (INT), Powerful others (PO) and Chance (CH)

The Paulhus Spheres of Control Inventory has three subscales: Personal control (PERS), Interpersonal control (INTPERS) and Socio-political control (SOCPOL). These can be summed to give a total score (PAUTOT)

The EPI has two subscales Extraversion (EXTVER) and Neuroticism ((INSTAB) plus a lie scale (LIE)

The Type A scale of the OSI has three subscales, Attitude to living (ATT), Style of Behaviour (STY) and Ambition (AMB), plus a composite Broad View (BRVIEW). The three subscales are also summed to give a total score (OSITOT). Only BRVIEW, STY & OSITOT are shown above.

On the basis of the above variables, a correlation matrix was constructed shown in Table 4.2.
The directions of the scores are as follows.

LEVENSON Locus of Control

INT ('Internal'): the higher the score the LESS the internality and the MORE the externality

PO ('Powerful Others'): the higher the score the LESS the belief that powerful others control one's life

CH ('Chance'): the higher the score the LESS the belief that chance or fate / destiny controls one's life

PAULHUS Spheres of Control

PERS ('Personal control'): the higher the score the LESS the internality and personal control

INTPERS ('Interpersonal control'): the higher the score the LESS the interpersonal control

SOCPOL ('Sociopolitical control'): the higher the score the LESS the sociopolitical control

EPI

EXTVER ('Extraversion'): the higher the score the more the extraversion

INSTAB ('Instability'): the higher the score the more the instability

TYPE A

STY ('Style of behaviour'): (for positive items) the higher the score the higher the Type A behaviour pattern

BRVIEW (Broad view of Type A): (for positive items) the higher the score the higher the Type A behaviour pattern

OSITOT (Total score of ATT, STY, and AMB subscales summed): (for positive items) the higher the score the higher the Type A behaviour pattern

ATTITUDES: CAS & DCAS

CANXI (CAS subscale - Computer Anxiety on Test 1): the higher the score the LESS the computer anxiety and the better the computer attitude

CCON1 (CAS subscale - Computer Confidence on Test 1): the higher the score the more the computer confidence and the better the computer attitude

CLIK1 (CAS subscale - Computer Liking on Test 1): the higher the score the more the computer liking and the better the computer attitude

DCASI (Durham Computer Attitude Scale): the higher the score the better the computer attitude (and the more the computer liking)

STRESS (COX)

STRBEF (*Stress before*): the higher the score the higher the levels of stress. It is the SACL score before computer interaction.

STRAFT (*Stress after*): the higher the score the higher the levels of stress. It is the SACL score after computer interaction.

CPTOT (*Subjective stress ratings*): the higher the score the higher the levels of stress, anger, frustration, helplessness, etc after computer session

PERF Performance on the computer tasks set; the higher the score the better the performance (ARCSPERF is shown)

SUBJ: Subjective difficulty of the computer tasks: the higher the score the LESS the subjective difficulty as self-rated after computer interaction (SUBLOG reverses this sign).

Correlations between personality, and initial attitudes, stress, performance and subjective difficulty variables are shown in table 4.2

Table 4.2 Correlation matrix for all variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1 INT	1.00																			
2 CH	-0.30 **	1.00																		
3 PO	-0.51 **	-0.06	1.00																	
4 PERS	0.01	-0.43 **	-0.12	1.00																
5 INTPERS	0.07	-0.35 **	0.00	0.44 **	1.00															
6 SOCPOL	0.07	-0.32 **	0.01	0.27 **	0.23 **	1.00														
7 EXTVER	-0.03	0.06	-0.07	-0.16 **	-0.52 **	-0.04	1.00													
8 INSTAB	0.01	-0.31 **	0.05	0.24 **	0.33 **	0.11	-0.16 **	1.00												
9 BRVIEW	-0.04	0.17 **	0.16 **	-0.38 **	-0.41 **	-0.05	0.32 **	-0.05	1.00											
10 STY	0.05	0.06	0.12 *	-0.22 **	-0.25 **	-0.07	0.29 **	0.12	0.56 **	1.00										
11 OSITOT	0.04	0.12	0.18 **	-0.38 **	-0.30 **	-0.14 *	0.18 **	0.07	0.75 **	0.79 **	1.00									
12 CANX1	-0.11	0.15 *	-0.06	-0.22 **	-0.18 **	-0.08	0.18 **	-0.24 **	0.22 **	0.08	0.11	1.00								
13 CCON1	-0.03	0.12	-0.06	-0.24 **	-0.17 **	-0.11	0.08	-0.22 **	0.17 **	0.07	0.14 *	0.83 **	1.00							
14 CLK1	0.01	-0.05	-0.06	-0.10	0.01	-0.05	-0.01	-0.11	0.08	0.04	0.12	0.69 **	0.73 **	1.00						
15 DCAS1	-0.06	0.09	-0.06	-0.16 *	-0.10	-0.09	0.06	-0.15 *	0.14 *	0.07	0.10	0.77 **	0.79 **	0.79 **	1.00					
16 STRBEF	-0.03	-0.19 **	0.06	0.24 **	0.17 *	0.05	-0.16 **	0.30 **	-0.03	0.02	0.04	-0.39 **	-0.37 **	-0.19 **	-0.33 **	1.00				
17 STRAFT	0.14 *	-0.22 **	-0.06	0.24 **	0.16 *	0.04	-0.08	0.29 **	-0.05	0.04	0.03	-0.32 **	-0.32 **	-0.18 **	-0.29 **	0.70 **	1.00			
18 CPTOT	0.23 **	-0.24 **	-0.03	0.27 **	0.21 **	0.04	-0.11	0.24 **	-0.20 **	-0.09	-0.14	-0.50 **	-0.54 **	-0.37 **	-0.48 **	0.47 **	0.61 **	1.00		
19 SUBJLOG	0.14 *	-0.20 **	-0.02	0.13	0.17 *	0.08	-0.03	0.15 *	-0.14 *	-0.07	-0.09	-0.43 **	-0.46 **	-0.30 **	-0.41 **	0.37 **	0.39 **	0.74 **	1.00	
20 ARCSPER	-0.16 **	-0.12	0.13 *	0.10	0.03	0.02	0.02	0.02	0.10	0.08	0.06	0.13 *	0.14 *	0.12 *	0.18 **	0.03	-0.06	-0.17 *	-0.18 **	1.00

* p<.05 **p<.01

I. Locus of control

Table 4.2 presents the correlations between locus of control, and initial attitudes, stress, performance, and subjective difficulty variables.

a) Correlations between locus of control and initial attitudes.

The first research question asked was the following: Do dimensions of locus of control relate to computer attitudes, including computer anxiety? Is it an internal or an external perception of control that positively correlates with (initial) computer attitudes?

For Levenson's locus of control subscales, there was only one significant correlation, and that was between computer anxiety and chance (CH) ($r = 0.15$). Specifically, the less the subjects' belief that chance, fate, or destiny controls their lives, the less their general computer anxiety was likely to be.

Since locus of control can be considered as a more 'permanent' set of beliefs than attitudes and although a correlation cannot imply causality, it seems likely that lack of belief that chance controls an individual's life, as measured by Levenson's subscale, may contribute to more positive (anxiety-free) attitude towards computers.

This correlation confirmed the findings related to Paulhus' scales. Here, the main point that arises out of the correlation findings is the subjects' initial attitudes' pattern of correlation with Paulhus' 'Personal' (PERS) and 'Interpersonal' (INTPERS) locus of control variables. Table 4.2 shows four significant ($p < 0.01$) and positive correlations between two of the initial scores of CAS' subscales (computer anxiety – CANX1, and computer confidence – CCON1) and the scores on Personal and Interpersonal control. These correlations mean that the higher the score the subjects had in 'personal' and 'interpersonal' control, the more likely they were to score low on computer anxiety and computer confidence. That, in turn, means that the more the subjects' personal and interpersonal control, the less anxious and the more confident they were likely to be towards computers.

These results were partially echoed in the DCAS data. So, similarly, the correlation ($r = -0.16$) between the score on personal control and the initial score of the Durham Computer Attitude Scale (DCAS1), was significant ($p < 0.05$). That means that positive changes in DCAS scores tend to be accompanied by negative changes in personal control scores. In particular, the greater the level of perceived personal control, the more positive the subjects' attitude towards computers.

In general, while correlations between locus of control variables and initial computer attitudes are small, they are significant. Interestingly, computer confidence and computer anxiety, both in relation to personal control, give the largest correlations. Now, it may be that although

experience seemed to be a good predictor of attitudes (see chapter two), computer confidence and anxiety as measured by CAS, and to a lesser extent general computer attitude as measured by DCAS, may also be a function of ('personal') locus of control. Similarly, computer anxiety may be a function of experience as well as a function of 'personal' control.

In view of the previous correlations findings, it would appear that there is a close relationship between locus of control, as measured especially by Paulhus' ('personal') subscale, and two dimensions of (initial) computer attitudes (anxiety and confidence), as measured by the respective subscales of CAS, as well as general computer attitude as measured by DCAS. Although correlations should not be interpreted as cause-and-effect relationships, it may be reasonable to assume that more internal personal control, as measured by Paulhus' (sub)scale, produce more positive and anxiety-free attitudes towards computers, as measured by CAS and DCAS.

In considering the relationship between computer attitudes and stress and performance, it may also seem reasonable to anticipate that internal 'personal' control, as a moderator, can reduce experienced computer stress and improve computer performance. However, these issues will be looked at separately within the correlations of locus of control and stress and performance variables.

Finally, it should be noted that no locus of control subscale correlated in any way with computer liking (CLIK1), as measured by the CAS.

As a summary, some of the general main points of the correlations between locus of control and attitude scales are: a) There is little relationship between Levenson's and attitude (sub)scales, apart from the one between 'chance' and computer anxiety ($r = 0.15$). b) Paulhus' measure gives a stronger relationship between PERS and INTPERS (sub)scales, and the CAS (sub)scales of CANX1 and CCON1. c) Neither locus of control scale shows much relation to the 'liking' (sub)scale of CAS. d) Only Paulhus' PERS relates to DCAS.

In considering the extent to which computer experience and/or 'personal' locus of control were good predictors of attitudes (as measured by CAS and DCAS), while Morrow et al found computer experience to be a better predictor of computer anxiety (regarded as part of computer attitudes) than locus of control, Woodrow generally found locus of control to account for more variation in computer attitudes than computer experience.

Thus, for the present study, stepwise regressions were conducted to see whether locus of control or experience carries more weight in predicting computer attitude. Within this context, computer experience was expressed as a dummy variable (D4) that contrasts the 'high' experience group (group 4) with all others. As seen in chapter two, the 'high' group was the

only group that significantly differed from all others on initial computer attitude as well as on change on attitude as a result of a computing course. Levenson's locus of control subscales and experience (INT, CH, PO, and D4) or Paulhus' SOC and experience (PERS, INTPERS, SOCPOL, and D4) were used as independent variables respectively.

Computer anxiety, computer confidence, computer liking, and DCAS were regarded as the dependent variables respectively. A summary of the regressions is shown in Table 4.3.

Table 4.3. Multiple Regressions of Locus of Control and Experience on Computer Attitudes.

a) Dependent Variable: CANX1 (Computer Anxiety)

Levenson: Model Summary

Model	Predictors	R	R ²	Adj. R ²	ΔR ²	Beta	Sig.
1	D4	.257	.066	.062	.066	.257	.000
2	D4 CH	.299	.089	.082	.023	.257 .153	.000 .003

Paulhus: Model Summary

Model	Predictors	R	R ²	Adj. R ²	ΔR ²	Beta	Sig.
1	D4	.301	.090	.086	.090	.301	.000
2	D4 PERS	.353	.125	.117	.034	.278 -.186	.000 .003

b) Dependent Variable: CCON1 (Computer Confidence)

Levenson: Model Summary

Model	Predictors	R	R ²	Adj. R ²	ΔR ²	Beta	Sig.
1	D4	.342	.117	.113	.117	.342	.000
2	D4 CH	.362	.131	.124	.014	.342 .120	.000 .046

Paulhus: Model Summary

Model	Predictors	R	R ²	Adj. R ²	ΔR ²	Beta	Sig.
1	D4	.367	.135	.131	.135	.367	.000
2	D4 PERS	.418	.175	.167	.040	.342 -.202	.000 .001

c) Dependent Variable: CLIK1 (Computer Liking)

Levenson: Model Summary

Model	Predictors	R	R ²	Adj. R ²	ΔR ²	Beta	Sig.
1	D4	.249	.062	.058	.062	.249	.000

Paulhus: Model Summary

Model	Predictors	R	R ²	Adj. R ²	ΔR ²	Beta	Sig.
1	D4	.243	.059	.055	.059	.243	.000

d) Dependent Variable: DCAS1

Levenson: Model Summary

Model	Predictors	R	R ²	Adj. R ²	ΔR ²	Beta	Sig.
1	D4	.288	.083	.079	.083	.288	.000
2	D4 INT	.314	.099	.091	.016	.308 .126	.000 .042

Paulhus: Model Summary

Model	Predictors	R	R ²	Adj. R ²	ΔR ²	Beta	Sig.
1	D4	.296	.088	.084	.088	.296	.000
2	D4 PERS	.330	.109	.101	.021	.278 -.145	.000 .023

It is apparent, from Table 4.3, that in all cases experience explains more variation in computer attitudes than locus of control. When Levenson's subscales and experience were regressed on each of the CAS' subscales, among all Levenson's dimensions only 'chance' (CH) contributed to the model. However, when Levenson's subscales and experience were regressed on DCAS1, then 'internality' (INT) rather than 'chance' made the only contribution to the model.

On the other hand, when Paulhus' subscales and experience were regressed on either each of the CAS subscales or DCAS1, only 'personal' control among Paulhus' dimensions significantly contributed to the model.

It is noteworthy here that experience relates most strongly to computer confidence; in spite of this however, it only explains 13.5% at maximum (see Table 4.3b). This finding indicates that attitudes are **not** a result of **just** experience.

b) Correlations between locus of control and three indices of stress.

The second research question asked here was: Do dimensions of locus of control relate to stress before and after computer sessions? If so, is it an internal or an external perception of control that correlates positively with computer stress? (Table 4.2).

As expected, in considering the relationship between locus of control and computer stress [stress before computer interaction (STRBEF) and stress after computer interaction (STRAFT), both as measured by Cox's SACL)], low levels of belief in chance (CH), as measured by Levenson's subscale, was significantly (cor)related to lower levels of stress, as measured by SACL before and after computer interaction. And 'stress after' (but not 'stress before') computer interaction was found to be (cor)related to Levenson's internality (INT) of locus of control, in that higher levels of internality was associated with lower SACL stress after computer interaction.

In support of this, there were significant correlations between these stress scores and the scores of personal (PERS) and interpersonal (INTPERS) control on Paulhus' subscales. These correlations mean that higher computer stress before and after computer interaction, tends to be accompanied by less (internal) personal control, and less (internal) interpersonal.

These results were echoed in the case of the subjective stress ratings (CPTOT). In particular, there were significant correlations between the score of the ratings (CPTOT) and the scores of personal and interpersonal control (correlation coefficients 0.27 and 0.21 respectively).

That means that the higher the scores the subjects had on Paulhus' personal and interpersonal control subscales, the more likely they were to score high on the stress ratings. That, in turn, means that the more external the personal and the interpersonal control, the more likely the subjects were to experience and report high stress (including anger, frustration, etc) after actual computer operation.

In considering the relationship between Levenson's locus of control and the subjective stress ratings, there were also two significant correlations, between the score of the CPTOT and the scores of Internal control (INT, $r = 0.23$) and the Chance (CH, $r = -0.24$).

These correlations mean that the more external the locus of control and the more the subjects' belief that chance control their lives, the more likely they were to experience high stress, anger, frustration, etc after computer interaction, as assessed by the measure of 'subjective ratings'.

c) Correlations between locus of control, and performance and subjective difficulty.

The third research question asked here was: Does locus of control relate to performance and subjective difficulty in computing tasks? If so, is it an internal or an external perception of control that correlates positively with performance and subjective difficulty?

No significant correlations were found between performance (ARCSPERF) and any of the Paulhus' subscales. However, in considering Levenson's subscales there were two significant correlations between performance and 'internality' ($r = -0.16$), and between performance and 'powerful others' (PO) ($r = 0.13$).

These correlations mean that the more internal the subjects' locus of control was (as measured by Levenson's subscale) the better the performance they were likely to achieve when completing various computer tasks. And the less the subjects' belief that powerful others mainly control their lives (i.e. the less the externality), the more likely they were to perform better in computing.

In the case of subjective difficulty (SUBJLOG), there was one significant correlation found between subjective difficulty and the Paulhus' 'interpersonal' control subscale. This correlation indicated that the less the interpersonal control, the more the subjective difficulty experienced when dealing with particular computer tasks during actual computer operation. (As a reminder, note that SUBJLOG has reversed the sign of SUBJ).

However, in considering Levenson's subscales there were two significant correlations between subjective difficulty and 'chance' ($r = -0.20$), and between subjective difficulty and 'internality' ($r = 0.14$). In particular, the less the belief in chance (i.e. the less the externality), the less the subjective difficulty experienced when dealing with particular computer tasks during actual computer operation. And the more the internality, the less the subjective difficulty.

It should be noted here that no measure of attitude, stress, performance or subjective difficulty correlated in any way with Paulhus' 'sociopolitical' control (SOCPOL) subscale.

II. Type A

Table 4.2 presents the correlations between the Type A behaviour pattern, and initial attitudes, stress, performance and subjective difficulty variables.

a) Correlations between Type A and initial attitudes

The first research question asked here was: Do dimensions of Type A-B personality construct (or behaviour pattern) relate to attitudes (including anxiety) towards computers?

'Style of behaviour' (STY) subscale was selected to participate in the correlations because it was thought that more than any other of the Type A subscales reflects the Type A characteristic of haste (together with other characteristics of the behavioural component of type A pattern, such as speed and abruptness of behaviour).

However, the main point that arises out of the correlation findings is that only 'Broad view of Type A' correlated with initial computer anxiety and computer confidence as measured by the CAS. It should be noted that the 'Broad view of Type A' score may provide a better measurement (compared to all the other Type A subscales) because of its representative power of the total Type A scale, i.e. because of the strength of its items which provide concisely and representatively the most significant Type A characteristics.

There was a significant correlation ($r = 0.22$) between the 'Broad view of Type A' (BRVIEW) and computer anxiety (CANX1); and an also significant correlation ($r = 0.17$) between the BRVIEW and computer confidence (CCON1). That means that the higher the subjects' A typology the less anxious and the more confident they were likely to be towards computers.

These findings were partially echoed in two small but significant correlations: one between 'Broad view of Type A' (BRVIEW) and DCAS1 ($r = 0.14$), and another between computer confidence and the total Type A score (OSITOT). Correlations of marginal significance were found between OSITOT, computer anxiety, computer liking, and DCAS1. However, no significant correlation was found between BRVIEW and computer liking, as measured by the CAS. And no significant correlation was found between 'style of behaviour' (STY) Type A subscale and any of the attitude variables.

In general, it is clear that high scores in Type A (sub)scales correspond to less anxiety, more confidence, more liking, and in general more positive attitudes towards computers.

b) Correlations between Type A and three indices of stress.

The second research question here was: Do dimensions of A-B Typology relate to stress before and after computer sessions?

In considering stress, as measured by SACL, no (cor)relation was found between stress before, stress after, and any of the Type A measures. However, there was a significant negative correlation between stress (including anger, frustration, helplessness, etc), as measured by the subjective ratings (CPTOT), and the 'broad view of Type A' score ($r = -0.20$).

Although no relation was found between SACL stress and Type A subscales, from the relation between BRVIEW and CPTOT, it seems clear that the higher the subjects' Type A behaviour pattern, the lower their levels of stress together with anger, frustration, and helplessness after actual computer operation.

c) Correlations between Type A, and performance and subjective difficulty.

The third research question here was: Does A Typology relate to (a) performance and (b) subjective difficulty in computing tasks?

Although there was no significant (cor)relation between A typology and performance, a significant correlation ($r = -0.14$) was found between the 'Broad view of Type A' (BRVIEW) and subjective difficulty (SUBJLOG).

In this case, the higher the subjects' Type A behaviour pattern the less the difficulty experienced when dealing with particular computer tasks during computer sessions.

In the main, there was only little relation between the Type A pattern (as measured by OSI) and any of the outcome variables apart from BRVIEW. 'Broad view of Type A' (BRVIEW) was the only Type A variable showing a sustained set of correlations with outcome variables.

III and IV. Instability and Extraversion

Instability

Table 4.2 presents the correlations between instability, and initial attitudes, stress, performance and subjective difficulty variables.

a) Correlations between instability and initial attitudes.

The first research question here was: Does neuroticism (instability) relate to attitudes (including anxiety) towards computers?

The main point that arises out of the correlation findings is the subjects' scores on neuroticism (or instability, INSTAB) pattern of correlation with initial computer anxiety and computer confidence. There were two significant correlations between INSTAB and CANX1, and between INSTAB and CCON1 (correlation coefficients -0.24 and -0.22 respectively). That means that the more unstable (or neurotic) the subjects were, the more anxious and the less confident they were likely to be about thinking of or using computers.

Similarly, there was a significant negative correlation between instability and computer attitude, as measured by the DCAS1 ($r = -0.15$). This correlation shows that the more unstable the subjects scored on EPI, the worse the attitude they were likely to have towards computers.

b) Correlations between instability and three indices of stress

The second research question here was: Does neuroticism relate to stress before and after computer sessions?

The results especially regarding instability and computer anxiety were also echoed in the stress data, as measured by Cox's SACL and the subjective (stress) ratings. In particular, there were two significant correlations between instability, and stress before ($r = 0.30$) and stress after computer interaction ($r = 0.29$). There was also a significant correlation between instability and the subjective stress ratings (CPTOT, measuring stress, anger, frustration, etc) ($r = 0.24$).

These correlations show that the higher the subjects' scores on instability, the higher the levels of stress they were likely to experience before and after computer interaction, and the higher the levels of stress, anger, frustration, etc they were likely to experience after actual computer operation.

c) Correlations between instability, performance and subjective difficulty.

The third research question here was: Does neuroticism relate to performance and subjective difficulty in computing tasks?

There was no significant (cor)relation between instability and performance, a finding showing that neuroticism (another name for instability) is a factor that does not influence computer performance significantly. However, there was a significant correlation between instability and subjective difficulty (SUBJLOG) ($r = 0.15$), in that the higher the instability scored on EPI, the more the difficulty experienced when dealing with particular computer tasks during actual computer operation.

Extraversion

Table 4.2 presents the correlations between extraversion, and initial attitudes, stress, performance and subjective difficulty variables.

a) Correlations between extraversion and initial attitudes

The first research question here was: Does extraversion relate to attitudes towards computers?

Extraversion (EXTVER), as measured by the EPI, was found to correlate significantly with initial computer anxiety (CANX1), as measured by the CAS, but neither with confidence and liking as measured by the CAS nor with general computer attitude as measured by the DCAS. In particular, the higher the subjects' scores on the extraversion subscale of the EPI the less the anxiety towards thinking about or using computers.

b) Correlations between extraversion and three indices of stress

The second research question here was: Does extraversion relate to stress before and after computer sessions?

A similar to the previous result was found for the correlation between extraversion and stress before computer interaction. The correlation between extraversion and stress before was significant with $r = -0.16$. This negative correlation showed that increases in the extraversion score, as given by the EPI, tend to be accompanied by decreases in stress before computer interaction, as measured by SACL. However, no significant correlation was found between extraversion and stress after computer interaction, as measured by SACL. Similarly, no significant correlation was found between extraversion and stress, frustration, anger, etc, as measured by the subjective ratings (CPTOT) after computer operation.

c) Correlations between extraversion, and performance and subjective difficulty.

The third research question here was: Does extraversion relate to performance and subjective difficulty in computing tasks?

The lack of a significant correlation between extraversion and computer performance indicates that the latter is probably independent and irrelevant to the personality trait of extraversion. Finally, no (cor)relation was found between extraversion and subjective difficulty.

V. General

The last question specified in the aims of the present chapter was:

Does information on personality variables (i.e. locus of control, type A, extraversion, and neuroticism) add or contribute anything to the variance of computer stress and performance, over and above initial computer attitudes?

In order to answer this question, multiple regression analysis was conducted to look at the contribution of the personality and attitude variables to the outcome. For each of the regressions, the dependent variable was one of the following: performance (ARCSPERF), subjective difficulty (SUBJLOG), stress before computing sessions (STRBEF), stress after computing sessions (STRAFT), or the subjective ratings indicating stress, frustration, anger, etc, after computer sessions (CPTOT).

The independent variables for each of the regressions were some of the dimensions of each of the locus of control scales [Levenson's Internal (INT) and Chance (CH), and Paulhus' Personal (PERS) and Interpersonal (INTPERS) control], EPI's neuroticism [or instability (INSTAB)] and extraversion (EXTVER), OSI's Broad View of Type A (BRVIEW), and the CAS' attitude dimensions of (initial) computer anxiety (CANX1) and confidence (CCON1).

The personality variables were selected on the basis of their correlation with the dependent variables, and their representative power of the measure to which they belong. (These variables were INT, CH, PERS, INTPERS, INSTAB, EXTVER, and BRVIEW). The attitude variables

were selected on the basis of their correlation with the dependent variables. Also, CCON1 was selected for its primarily strong significant contributions in the regressions of Chapter Three, and CANX1 in an attempt to find out the extent to which computer anxiety could predict the dependent variables (seen as an important and interesting question).

As previously, before conducting multiple regressions, results of evaluation of assumptions led, where appropriate, to transformation of the variables to reduce skewness in their distributions, remove the outliers, and improve the normality, linearity and homoscedasticity of residuals. In particular outliers were removed as standard.

Stepwise regression procedure in SPSS for Windows was used to investigate the relative contributions of personality and attitude. Multiple R's, R Squares, Adjusted R Squares, R Square differences, Beta weights, and significance levels were considered.

There was some concern that the cases to variables ratio was rather low for stepwise regression procedure. Regressions were subsequently checked with a smaller set of variables entered to make sure that there were no marked distortions in the data.

Table 4.4. Multiple Regression. Dependent Variable: ARCSPERF

Model	Predictors	R	R ²	Adj. R ²	ΔR^2	Beta	Sig.
1	INT	.196	.038	.034	.038	.196	.005
2	INT CH	.278	.077	.068	.039	.256 -.206	.000 .004
3	INT CH CCON1	.316	.100	.086	.023	.259 -.227 .151	.000 .002 .026

Personality with attitudes, and performance

Within the multiple regressions of Chapter Three, it was found that only CCON1 can be considered as a weak predictor of computer performance. The question, then, is: are the personality or the attitude variables better predictors of performance? After considering the correlations, the suspicion here was that both subjects' personality (and in particular locus of control as measured by Levenson) **and** their attitudes towards computers (especially confidence as measured by CAS) should contribute to the outcome of performance.

In order to test this expectation and discover the relative contribution of personality and attitude variables to performance, a stepwise multiple regression was conducted using as the independent variables, the personality and attitude variables specified before. Arcsine performance (ARCSPERF) was regarded as the dependent variable. A summary of the regression is shown in Table 4.4.

The variable entered on the first step was the INT (Levenson's internal locus of control) (see Table 4.4). The most obvious feature of the output was the multiple correlation coefficient which was given as 0.196 (R square was 0.038). On the second step, the decision of the stepwise program was to include CH [Chance, Levenson's locus of control (sub)scale]. It was seen from the results that the addition of CH improved considerably the predictive power of the regression equation: the value of Multiple R was now 0.278, R square was 0.077, and the beta weights were -0.206 for CH, and 0.256 for INT.

The decision of the stepwise program was to also include CCON1. Once more, it was seen from the results that the addition of CCON1 improved even further the predictive power of the regression equation: the value of Multiple R was now 0.316, R square was 0.100, and the beta weights were -0.227 for CH, 0.259 for INT, and 0.151 for CCON1.

The decision of the stepwise program was that the increment in R with the inclusion of the remaining independent variables was not robust, and so those variables were dropped from the final equation.

In the main, internality, as measured by Levenson's (sub)scale, and to a lesser extent belief in chance, as measured by Levenson, and computer confidence, as measured by the CAS respective subscale, may be considered as considerable predictors of performance on various computing tasks.

Interestingly, the best predictors of performance are personality variables (i.e. Levenson's LOC) rather than attitudes – although it should be noted that these personality variables account for only a small proportion of variance. Additionally, in order to assess the effects of adding the 'experience' (D4) dummy variable to the model, subsequent analysis was conducted (not shown in tables). This analysis indicated that computing experience played no part in predicting performance.

So, in considering personality and attitudes together, the personality variables of internality of locus of control (INT) and belief in chance (CH) are better predictors of performance compared to the attitude variable of computer confidence (CCON1). The suspicion that both personality **and** attitudes towards computers contribute to performance was confirmed by the results of multiple regression, with personality (locus of control) being overall a better predictor of performance than attitudes.

Table 4.5. Multiple Regression. Dependent Variable: SUBJLOG

Model	Predictors	R	R ²	Adj. R ²	ΔR^2	Beta	Sig.
1	CCON1	.432	.187	.183	.187	-.432	.005
2	CCON CH	.459	.211	.203	.024	-.410 -.157	.000 .015

Personality with attitudes, and subjective difficulty

Within the multiple regressions of Chapter Three, it was found that only computer confidence (CCON1) can be considered as a moderately strong predictor of subjective difficulty (SUBJLOG). As before with performance, the question is: are the personality or the attitude variables better predictors of subjective difficulty? After again considering the correlations, the suspicion here was that both subjects' personality **and** their attitudes towards computers should contribute to the outcome of subjective difficulty.

A stepwise procedure was then run. A summary of the regression is shown in Table 4.5. Differently to performance, the variable entered on the first step was (initial) computer confidence (CCON1). The multiple correlation coefficient was given as 0.432 (R square was 0.187). On the second step, the decision of the stepwise program was to include CH [Chance, Levenson's locus of control (sub)scale]. It was seen from the results that the addition of CH only slightly improved the predictive power of the regression equation: the value of Multiple R was now 0.459, R square was 0.211, and the beta weights were -0.157 for CH, and -0.410 for CCON1. The decision of the stepwise program was that the increment in R with the inclusion of the remaining independent variables was not robust, and so those variables were dropped from the final equation.

As with performance, in order to assess the effects of adding the 'experience' (D4) dummy variable to the model, subsequent analysis was conducted (not shown in tables). This analysis indicated that computing experience played no part in predicting subjective difficulty.

In the main, computer confidence, as measured by the respective CAS (sub)scale, may be considered as a fairly strong (attitude) predictor of subjective difficulty; belief in chance, as measured by the Levenson's locus of control respective subscale, may be seen as slightly contributing to the outcome of subjective difficulty.

So, generally, in considering the effect of personality and attitudes together on subjective difficulty, **both** attitudes **and** personality were found to contribute to the difficulty experienced when completing computing tasks, with attitudes (in particular confidence) being overall a much stronger predictor of subjective difficulty compared to personality (in particular, belief in chance).

Table 4.6. Multiple Regression. Dependent Variable: STRBEF

Model	Predictors	R	R ²	Adj. R ²	ΔR^2	Beta	Sig.
1	CANX1	.380	.144	.140	.144	-.380	.000
2	CANX1 INSTAB	.445	.198	.190	.054	-.310 .243	.000 .000

Personality with attitudes, and stress before

In order to investigate the relative contribution of personality and attitudes variables to stress before computer interaction (as measured by Cox), stepwise multiple regressions were conducted using again INT, CH, PERS, INTPERS, INSTAB, EXTVER, BRVIEW, CCON1, and CANX1 as independent variables. Stress before (STRBEF) was regarded as the dependent variable.

A stepwise procedure was then run (see Table 4.6). The variable entered on the first step was the CANX1. The multiple correlation coefficient was given as 0.380 (R square was 0.144). The decision of the stepwise program was to include INSTAB. It was seen from the results that the addition of INSTAB improved the predictive power of the regression equation: the value of Multiple R was now 0.445, R square was 0.198, and the beta weights were -0.310 for CANX1, and 0.243 for INSTAB.

The decision of the stepwise program was that the increment in R with the inclusion of the remaining independent variables was not robust, and so those variables were dropped from the final equation. In the main, computer confidence, as measured by the CAS (sub)scale, may be considered as a considerable predictor of 'stress before'; instability (or neuroticism), as measured by the EPI (sub)scale, may be seen as significantly contributing to the outcome of 'stress before'.

As before, subsequent analysis was conducted in order to study the effects of adding the 'experience' (D4) dummy variable to the model (not shown in tables). This analysis indicated that computing experience significantly added only 2% to the variance of the outcome of 'stress before'.

So, generally, in considering the effect on initial stress of personality and attitudes together, **both attitudes and personality** were found to contribute to stress experienced before computer interaction, with attitudes (in particular computer anxiety) being overall a stronger predictor of 'stress before' compared to personality (in particular instability).

It makes sense that both domain specific computer anxiety (CANX1) and general anxiety (INSTAB) should contribute to stress prior to computer sessions. This could be interpreted as related to anticipatory (to a computer session) anxiety.

Table 4.7. Multiple Regression. Dependent Variable: STRAFT

Model	Predictors	R	R ²	Adj. R ²	ΔR ²	Beta	Sig.
1	CCON1	.394	.155	.151	.155	-.394	.000
2	CCON1 INSTAB	.439	.193	.185	.038	-.344 .200	.000 .003
3	CCON1 INSTAB CH	.457	.209	.197	.016	-.338 .158 -.134	.000 .022 .047

Personality with attitudes, and stress after

In order to investigate the relative contribution of personality and attitudes variables to stress after computer interaction as measured by Cox’s SACL, stepwise multiple regressions were conducted using again INT, CH, PERS, INTPERS, INSTAB, EXTVER, BRVIEW, CCON1, and CANX1 as independent variables. Stress after (STRAFT) was regarded as the dependent variable.

A stepwise procedure was then run (see Table 4.7). The variable entered on the first step was the CCON1. The multiple correlation coefficient was given as 0.394 (R square was 0.155). The decision of the stepwise program was to include INSTAB. It was seen from the results that the addition of INSTAB improved the predictive power of the regression equation: the value of Multiple R was now 0.439, R square was 0.193, and the beta weights were -0.344 for CCON1, and 0.200 for INSTAB. The decision of the stepwise program was to also include CH. This improved the power of the equation even further, not much though: Multiple R was now 0.457, R square was 0.209, and the beta weights were -0.134 for CH, 0.158 for INSTAB, and -0.338 for CCON1.

The decision of the stepwise program was that the increment in R with the inclusion of the remaining independent variables was not robust, and so those variables were dropped from the final equation. In the main, computer confidence, as measured by the CAS (sub)scale, may be considered as a considerable predictor of ‘stress after’; instability, as measured by the EPI (sub)scale, and belief in chance, as measured by Levenson’s locus of control subscale, may be seen as variables contributing to a lesser extent to the outcome of stress after (STRAFT).

As before, subsequent analysis was conducted in order to assess the effects of adding the ‘experience’ (D4) dummy variable to the model (not shown in tables). This analysis indicated that computing experience played no part in predicting stress after computer sessions.

So, generally, in considering the effect on final stress of personality and attitudes together, mainly attitudes, confidence in particular, were found to contribute mostly to stress experienced after computer interaction. The personality variables of instability and locus of control were much weaker predictors of this outcome.

Table 4.8. Multiple Regression. Dependent Variable: CPTOT

Model	Predictors	R	R ²	Adj. R ²	ΔR ²	Beta	Sig.
1	CCON1	.688	.473	.469	.473	-.688	.000
2	CCON1 INTPERS	.706	.499	.491	.026	-.664 .162	.000 .012
3	CCON1 INTPERS INT	.721	.519	.508	.021	-.659 .173 -.144	.000 .006 .021

Personality with attitude, and subjective ratings

In the multiple regressions of Chapter Three, it was found that when using subjective ratings as the dependent variable, and computer attitudes as the independent, the majority of variance was accounted for by computer confidence (CCON1).

In order to investigate the relative contribution of personality and attitude variables to subjective ratings (indicating stress, amount of control, helplessness, frustration and anger reported after computer interaction), stepwise multiple regressions were conducted using again INT, CH, PERS, INTPERS, INSTAB, EXTVER, BRVIEW, CCON1, and CANX1 as independent variables. Subjective ratings (CPTOT) were regarded as the dependent variable.

A stepwise procedure was run (see Table 4.8). The variable entered on the first step was, as expected, the CCON1. In the output, the multiple correlation coefficient was given as 0.688 (R square was 0.473). The decision of the stepwise program was then to include INTPERS. It was seen from the results that the addition of INTPERS improved the predictive power of the regression equation only a little: the value of Multiple R was now 0.706, R square was 0.499, and the beta weights were 0.162 for INTPERS and -0.664 for CCON1. Finally, the stepwise program also decided to include INT. It was seen from the results that the addition of INT further improved, though only slightly, the predictive power of the regression equation: the value of Multiple R was now 0.721, R square was 0.519, and the beta weights were -0.144 for INT, 0.173 for INTPERS and -0.659 for CCON1.

In the main, computer confidence, as measured by the CAS (sub)scale, can be considered as a strong predictor of subjective ratings; interpersonal control, as measured by Paulhus' respective subscale, and internality of locus of control, as measured by Levenson's subscale, can be seen as variables contributing to a much lesser extent to the outcome of subjective ratings after computer interaction.

As in previous occasions, the 'experience' (D4) dummy variable was added to the model and subsequent analysis was conducted (not shown in tables) in order to study the effects. This analysis indicated that computing experience played no part in predicting subjective ratings.

So, generally, in considering the effect of personality and attitudes together, on stress, control, frustration, helplessness and anger reported after computer interaction: mainly attitudes, confidence in particular, were found to contribute mostly to the experienced outcome. Locus of control was a much weaker predictor of this outcome.

4.4 Discussion

1. Locus of control

In general, the results of this study relate to its aims as follows:

1. The first research question was: Do dimensions of locus of control relate to computer attitudes, including computer anxiety? Is it an internal or an external perception of control that positively correlates with (initial) computer attitudes?

The present correlations / results showed a significant association between higher levels of (internality of) both personal and interpersonal control (Paulhus) with lower levels of computer anxiety and higher levels of computer confidence (CAS). This result was supported: by (a) the significant association between higher levels of interpersonal control with more positive computer attitude, as measured by the DCAS; and (b) by the correlation finding that the less the subjects believed that chance controls their lives (Levenson) the less the computer anxiety they had.

These were interesting results which suggested that a person's positive or negative attitudes (including anxiety) towards computers have a lot to do with his/her perception of control. However, the important question emerging from the literature was: Is it an internal or an external perception of control that positively correlates with (initial) computer attitudes?

The main results here were derived from Paulhus' locus of control measure. It seems that an individual with an internal locus of personal control (i.e. with relatively high perceived competence or self-efficacy) is more likely to have more confidence, experience less anxiety,

and show a better attitude (the latter as additionally indicated by the DCAS) towards computer technology. This result seemed to confirm Coovert and Goldstein's (1980) as well as Wesley et al's (1985) findings that internals have overall a more positive and less negative attitude towards computers than externals. The results also confirmed Morrow et al's findings (1986) (reviewed in the introduction of chapter four) that higher externality of locus of control is significantly related to higher computer anxiety.

It also agreed with the more general literature on the locus of control construct suggesting that internals would be less prone to computer anxiety and negative computer attitudes because of their general confidence in their own ability to control and master challenges. However, the present results seemed to contradict Woodrow's (1990) findings which suggested that externals rather than internals have more positive attitudes towards computers.

Similar results were derived from Levenson's locus of control measure. In particular, the correlation findings between the anxiety CAS (sub)scale and 'Chance' Levenson's (sub)measure suggested that the belief that chance is the controlling force in an individual's life was related to computer anxiety - with 'less' computer anxiety having been associated with lower levels of belief in chance as a (perceived) life's major controlling force; thus, lower anxiety tended to correlate with lower externality (or higher internality). However, the results suggested that there was no significant relation between Levenson's internality or powerful others with any of the computer attitude dimensions.

Similarly to Coovert and Goldstein's (1980) findings, a possible hypothesis that those subjects with negative attitudes towards computers may view the computer as a powerful other and therefore a potential controlling factor in their lives was not upheld. No correlation between Levenson's 'powerful others' dimension and any of the attitude variables was significant. The reason that those with negative attitude towards computers did not tend to view the computer as a 'powerful other' may be explained by research performed by Orcutt and Anderson (1977). These authors, while using computers to study social interaction, found that subjects did not tend to personify the computer as much as they tended to dehumanise (human) others. Subjects then may actually be viewing the computer as a potential controlling factor in their lives but are not viewing it as a powerful (human) other, therefore invalidating the 'powerful other' dimension of Levenson's scale used in this context.

In addition, when control refers to the individual's interactions with others in dyads or group situations, then again an internal locus of interpersonal control (i.e. more perceived control over other people) is more likely to be accompanied by more confidence, less anxiety, and better general attitude (the latter as indicated by the DCAS) when interacting with computers.

It seems that, in general, people who feel a lot of control over their interpersonal relations are more likely to have positive attitudes towards computers.

That seems to contradict the popular notion and speculation that individuals who like computers a lot are not so happy or satisfied regarding their relations with the others. According to this view, those individuals are supposed to turn to computers as substitutes in an attempt to satisfy their original need for sociability, communication, and socially orientated creativity.

An extreme of this could be the group of individuals who have very opposite attitudes towards computers than 'computerphobics' have (Jay, 1981). "Hackers" (related to less interpersonal control) are so attracted to computer work that it becomes an obsession, to the extent of exclusion of other work and human relationships (Ingber, 1981). In Abler and Sedlacek's view (1987), "hackers" and computerphobic students are at the extreme ends of the range of student computer attitudes. However, the present results show that students with increased interpersonal control are more likely to have positive attitude towards computers and that "hackers" may only be an extreme minority.

On the other hand, when control refers to the possible conflicts between the individual's goals with those of the political and social system, as measured by Paulhus' 'sociopolitical control' (sub)scale, then no relation can be found between locus of control and any of the dimensions of computer attitude.

Previous research on computer attitudes, computer anxiety, and locus of control has not investigated the particular relationship between the interpersonal or sociopolitical behavioural spheres of control, and the levels of computer anxiety, confidence, and liking. And the differences between the relationships of computer attitudes to locus of control, as defined and measured by Paulhus', and computer attitudes and locus of control, as defined and measured by Levenson or any other researcher, may be to a certain extent depended on the differences between the definitions, the specific domain of reference, and the measurements of the locus of control construct. The present results suggested that there is a close relationship between computer attitudes and the locus of control pattern. However, additional research should further address this issue by comparing findings from the literature to results from studies involving similar to this study's **and** different conceptualisations, domains, and measurements of the locus of control variable.

For example, Palenzuela (1987) attempted to offer a critical evaluation of Paulhus and Christie's (1981 and 1983) approach to measurement of the locus of control construct. According to Palenzuela, this approach made a rather ambiguous use of the term 'perceived control'; in Palenzuela's view and from Paulhus and Christie's conceptual model, it was

unclear whether the term referred to perceived contingency only, to perceived competence, or to other constructs. Palenzuela's examination of the items of the 'personal efficacy' and 'interpersonal control' subscales suggested that they had more to do with perceived competence than with perceived contingency, especially the latter. Besides, Palenzuela, in his 1987 paper, attempted to provide empirical evidence in order to offer further support for the theoretical speculations he presented.

In considering locus of control and computer attitudes together with computer experience, the first research question also asked: Is computer experience a better predictor of computer attitudes (including computer anxiety) than locus of control? While Morrow et al (1986) found computer experience to be a better predictor of computer anxiety (regarded as part of computer attitudes) than locus of control, Woodrow (1990) generally found locus of control to account for more variation in computer attitudes than computer experience.

In order to answer this question, multiple regression analysis was conducted to look at the contribution of the locus of control and experience variables to the outcome. The present results clearly indicated that experience had a much stronger effect on computer attitudes than locus of control. Thus, the present results confirmed Morrow et al's findings but contradicted Woodrow's.

2. The second research question was: Do dimensions of locus of control relate to stress before and after computer sessions? And if so, is it an internal or an external perception of control that correlates positively with computer stress?

The present correlations results showed a significant association of higher levels of (internality of) personal control (Paulhus) with lower levels of stress before and after computer interaction (as measured by both SACL and subjective ratings). Results also indicated a significant association of higher levels of (internality of) interpersonal control (Paulhus) with lower levels of stress before and after computer sessions (SACL and subjective ratings). These results were supported: a) by the significant correlation finding that the less the subjects believed that chance controls their lives (Levenson) the less the computer stress they had before and after computer sessions (SACL and subjective ratings); and b) by the significant correlation finding that the more internal the locus of control (Levenson) the less the computer stress after computer sessions (SACL).

These were again very interesting results which suggested that a person's stress (as well as anger, frustration, helplessness, and amount of perceived control), related to computing, have a lot to do with his/her perception of control. However, again, the important question was:

Is it an internal or an external perception of control that positively correlates with computer stress?

The main results here were derived from Paulhus' locus of control measure. It seems that an individual with an internal locus of personal control (i.e. with relatively high perceived competence or self-efficacy) is more likely to experience less stress before and less stress (including anger, frustration, etc) after computing sessions. There is not a lot of either support or contradiction within the literature, as the relation between locus of control and computer stress as a dependent measure has been scarcely dealt with. However, given the inverse correlation of computer attitude and computer stress, this result seemed to go along indirectly with Coovert and Goldstein's (1980) as well as Wesley et al's (1985) findings: Since internals have overall a more positive attitude towards computers than externals, and since more positive attitude has been found to be associated with lower stress levels, then internals should experience lower computer stress levels than externals.

Since this result is similar to the one found about computer anxiety (as part of computer attitudes) before, it seemed to confirm the suggestion within chapter three that there is a close relationship between computer anxiety and computer-related stress, although this issue has not been addressed adequately either within this thesis or by the known relevant literature.

In general, within this thesis, computer anxiety has been treated as an independent 'attitude' construct, whereas stress as a 'non-attitude' dependent one. However, this distinction has not been clear in the scarce literature on computer stress. It is even sometimes the case that these two constructs have been used interchangeably in previous research.

In considering the relation between computer stress and anxiety, the results here, in a way, confirmed Morrow et al's findings (1986) (reviewed in the introduction of chapter four) that higher externality of locus of control is significantly related to higher computer anxiety and stress.

The present result would also agree with the more general literature on the locus of control construct suggesting that internals would be less prone to stress in general, and computer stress in particular, because of their general confidence in their own ability to control and master challenges. However, the present results may have indirectly contradicted Woodrow's (1990) findings which suggested that externals rather than internals have more positive attitudes towards computers, and thus externals probably rather than internals are more likely to experience lower levels of computer stress.

Similar results were derived from Levenson's locus of control measure. In particular, the correlation findings between all three indices of stress and 'Chance' Levenson's (sub)measure

suggested that the belief that chance is the controlling force in an individual's life was related to computer stress - with 'less' computer stress (including anger, frustration, etc) having been associated with lower levels of belief in chance as a (perceived) life's major controlling force; thus lower stress levels tended to correlate with lower externality (or higher internality). In support of this Levenson's internality was found to relate to stress after computer sessions.

However, the results suggested that there was no significant relation between Levenson's 'powerful others' dimension and any of the computer stress indices. Thus, a possible hypothesis that those subjects with high stress (including anger, frustration, etc) when interacting with computers may view the computer as a powerful other and therefore a potential controlling factor in their lives was not upheld.

In addition, when control refers to the individual's interactions with others in dyads or group situations, then again an internal locus of interpersonal control (i.e. more perceived control over other people) is likely to be accompanied by less stress before and after computer sessions [as indicated by the SACL and the subjective ratings (CPTOT)].

It seems that, in general, people who feel a lot of control over their interpersonal relations are less likely to experience computer stress.

It seems again that in general people who feel high levels of control over their interpersonal relations are more likely to experience 'less' stress, anger, etc when dealing with computers and computing. That seems to contradict the popular notion and speculation that individuals who feel least stressful with computers may not be so happy or satisfied regarding their relations with the others (since they don't feel in control of the respective behavioural sphere).

However, when control refers to the possible conflicts between the individual's goals with those of the political and social system, as measured by Paulhus' 'sociopolitical control' (sub)scale, then no relation can be found between locus of control and any of the computer stress variables.

Previous research on the relation between computer stress and locus of control has been scarce, inadequate and unclear. In addition, the relation of computer stress to locus of control may be to a certain extent depended not only on the differences between the definitions, the specific domain of reference and the measurements of the locus of control construct but also on the conceptualisation and context of the stress and anxiety constructs. The present results suggested that there is a close relationship between computer stress and the locus of control construct (at least as the latter is conceptualised and measured by Paulhus and Levenson). However, additional research should further address this issue by comparing different indices of stress (or

anxiety as a dependent measure) to various domains, conceptualisations and measurements of the locus of control variable.

3. The third research question was: Does locus of control relate to a) performance and b) subjective difficulty in computing tasks? And if so, is it an internal or an external perception of control that correlates positively with performance and subjective difficulty?

A. Performance

The present correlations results showed a significant association of higher levels of internality (INT, Levenson) with higher levels of performance (ARCSPERF). This result was supported by the significant correlation indicating that the less the subjects believed that powerful others control their lives (PO, Levenson) the better their performance in completing computing tasks.

This was an interesting result which suggested that a person's performance related to the completion of different computing tasks **does** have a relation with his/her perception of control. However, the important question again emerging from the literature was: Is it an internal or an external perception of control that positively correlates with computer performance?

The main results here were derived from Levenson's locus of control measure. It seems that an individual with an internal locus of control (as conceptualised and measured by Levenson) is more likely to achieve better performance when dealing with computer technology. This result seemed to confirm Wesley et al's (1985) findings that internals overall achieve better performance on various computer tasks than externals. It also agreed with the more general literature on the locus of control construct suggesting that internals would be more efficient in most activities and perform better on most situations because of their general confidence in their own ability to control and master challenges. Indeed, Levenson (1973) stated that her 'Internal' scale items are statements that "emphasise the competency of the individual in planning and having his hard work rewarded". However, the present results seemed to contradict Woodrow's (1990) findings which suggested directly or indirectly that externals rather than internals are more likely to perform better in computing.

In addition, given the positive correlation of computer attitude and computer performance, this result seemed (indirectly) to go along with Coover and Goldstein's (1980) as well as Morrow et al's (1986) findings: Since internals have overall a more positive attitude towards computers than externals, and since more positive attitude has been found to be associated with better performance, then internals should perform better than externals.

Similarly, the correlation findings between the index of performance and 'Powerful Others' Levenson's (sub)measure suggested that the belief that powerful others are the controlling force in an individual's life was related to computer performance - with better computer performance

associated with lower levels of belief in powerful others as a (perceived) life's major controlling force; thus higher performance levels tended to correlate with higher internality (or lower externality). However, the results suggested that there was no significant relation between Levenson's chance and the computer performance index.

So, higher levels of belief in 'powerful others' seem to be related directly with worse computer performance. External individuals with high levels of belief in 'powerful others' have a 'non-personal' locus of control and assume that powerful others and not they are in control of events. Thus, within this context, the computers (as powerful others) may have been viewed as the controlling force over the success in completing the computing tasks. Externals with a high 'powerful other' locus of control pattern may have believed that, whatever they do, they cannot be in control of a computer and that the outcome of their effort depends mainly on the (powerful other) computer. Consequently, this perception may have influenced their performance negatively.

This interpretation assumes that subjects with a high 'powerful others' external pattern also tend to personify the computer, since they view it more as a 'powerful other' rather than as a machine. Indeed Hall and Cooper (1991) have confirmed this view. The authors found that subjects' essays which described successful episodes while working on a computer were more often written using impersonal references to the computer; whereas essays describing failure episodes contained more personal and intimate terms for the computer. Hence, a possible initial hypothesis that those subjects performing worse when interacting with computers may view the computer as a powerful other, and therefore a potential controlling factor in their lives, may be considered to be upheld.

However, it should be noted that the 'powerful others' (PO) variable was not put into any of the regressions. When PO, as a check, was included into preliminary regressions along with INT and CH, it did not enter any of the regressions equations.

It should be noted that no significant relation was found between performance and any of the Paulhus locus of control dimensions.

As with computer stress, previous research on the relation between computer performance and locus of control has been scarce, inadequate and unclear. In addition, the relation of computer performance to locus of control may be to a certain extent depended not only on the differences between the specific domain of reference and the measurements of the locus of control construct but also on the nature of computing tasks measured and the actual measure of performance. The present results suggested that there is a close relationship between computer performance and the locus of control pattern. However, additional research should further

address this issue by correlating different performance measures on different computer tasks to various domains, conceptualisations and measurements of the locus of control variable.

B. Subjective difficulty

The correlations results showed a significant association between lower levels of belief in chance (higher internality) and lower levels of subjective difficulty. This result was supported: (a) by the significant association between higher levels of internality (Levenson) and lower levels of subjective difficulty; and (b) by the correlation finding that the more (internal) the interpersonal control (Paulhus) the less the amount of subjective difficulty experienced by subjects when completing various computing tasks.

This was an interesting result which suggested that a person's subjective difficulty related to the completion of different computing tasks **does** have a relation with his/her perception of control. The important question, again, was: Is it an internal or an external perception of control that positively correlates with experienced difficulty when completing various computing tasks?

The main results here were derived from Levenson's locus of control measure. It seems that an individual with an internal locus of control (as conceptualised and measured by Levenson) is more likely to experience less difficulty when dealing with computer technology.

Similarly, results derived from the correlation between the subjective difficulty (SUBJLOG) and 'Chance' Levenson's (sub)measure suggested that the belief that chance is the controlling force in an individual's life was related to difficulty - with less difficulty associated with lower levels of belief in chance as a (perceived) life's major controlling force. Thus, lower difficulty tended again to correlate with lower externality (or higher internality). However, the results suggested that there was no significant relation between Levenson's powerful others and the index of subjective difficulty.

In addition, when control refers to the individual's interactions with others in dyads or group situations, then again an internal locus of interpersonal control (i.e. more perceived control over other people) is more likely to be accompanied by lower levels of subjective difficulty experienced when dealing with various computer tasks. This correlation was consistent with the ones found for interpersonal control with attitudes and stress but not with performance.

It seems once more that in general people who feel more control over their interpersonal relations are more likely to experience less difficulty when dealing with computers and computing. That seems to place additional contradiction to the popular notion and speculation that individuals who are 'good' in computing may not be so happy or satisfied regarding

their relations with the others. In fact, according to the present results, these individuals are more likely to feel in control over their 'interpersonal' behavioural sphere.

However, when control refers to the possible conflicts between the individual's goals with those of the political and social system, as measured by Paulhus' 'sociopolitical control' (sub)scale, then no relation can be found between locus of control and subjective difficulty.

II. Type A

1. The first research question here was: Do dimensions of Type A-B personality construct (or behaviour pattern) relate to attitudes (including anxiety) towards computers? And if so, do computer attitudes correlate positively or negatively with A Typology?

The present correlations / results showed a significant association between higher levels of A Typology, as measured by the 'Broad view of Type A' subscale (BRVIEW), with lower levels of computer anxiety and higher levels of computer confidence (as measured by CAS). This result was supported: (a) by the significant association between higher levels of A Typology (BRVIEW) with more positive computer attitude, as measured by the DCAS; and (b) by the significant correlation finding that the higher the A Typology, as measured by the total Type A score (OSITOT), the more the subjects' computer confidence (CAS).

The main results here were derived from the 'Broad View of Type A' subscale. Here it seems that in general the higher the type A pattern the more positive the attitudes towards computers. A similar result was derived from the total type A score: In particular, the higher this score the more the subjects' computer confidence.

As previously discussed, the Type A behaviour pattern, as measured by the OSI (Occupational Stress Indicator), consists of: (a) an underlying cognitive perspective that individuals have regarding their lives and work (attitude to living, confidence, commitment, dedication, etc); (b) a behavioural component that individuals have regarding their style of behaviour (such as speed, abruptness, haste, etc); and (c) the 'ambition' component regarded as an individual's need for achievement.

Thus, according to the results, the higher the cognitive components (attitude to living), the higher the behavioural components (style of behaviour, STY) and the higher the need for achievement in an individual (ambition), as all measured by the OSI, the more the individual is likely to have 'better' computer attitudes, more confidence and experience less anxiety, as measured by CAS and DCAS.

However, and contrary to a possible relevant assumption, no (cor)relation was found between the behavioural component of type A [style of behaviour (STY): speed, abruptness, haste, etc]

on its own, and any of the computer attitude and anxiety variables. One of the reasons may have been the limited number of items (four only) involved within the 'style of behaviour' subscale. Whatever the reasons, a possible hypothesis that the impatience aspect of Type A subjects might affect their attitudes towards computers was not upheld.

The present results seemed to contradict Hart et al's findings (1987) that Type As may exhibit more stress and anxiety than Type Bs. It also contradicted the more general literature on the Type A personality construct suggesting that Type As would be more prone to anxiety and computer anxiety because of their general competitiveness, achievement striving, time urgency, impatience and hostility. The results also seem to indirectly negate Van Dijkhuizen and Reiche's (1980) finding that Type As report more psychological complaints.

There is hardly any previous research on the relation between computer attitudes, computer anxiety, and A typology. In addition, it is not very clear what exactly A typology is and what psychological processes underlie it. And, as explained before, not a lot of reliance should be placed on the OSI Type A measuring subscale.

Thus, the results on the relationships between computer attitudes and A Typology may be to a certain extent depended on the conceptualisation and the measurement of the Type A behavioural pattern. The present results suggested that there is at least some relationship between computer attitudes and A typology. However, additional research should address this issue by conducting similar studies but involving some other way of measuring the Type A personality variable (e.g. structured or semi-structured interviewing).

2. The second research question here was: Do dimensions of A Typology relate to stress before and after computer sessions? And if so, does computer stress correlate positively or negatively with A Typology?

The only significant association between A Typology and stress found was that higher levels of A Typology, as measured by the 'Broad view of Type A' subscale (BRVIEW), were associated with lower levels of stress (including anger, frustration, etc), as measured by the subjective ratings (CPTOT) reported after computer sessions. This result suggested that a person's experienced computer stress, frustration, anger, helplessness etc after computer interaction have at least some inverse relation with their A Typology behaviour pattern, in that the higher the Type A pattern the lower the stress (and relevant constructs).

In other words, the higher the score levels on the cognitive components such as confidence, commitment and dedication, the higher on the behavioural components such as speed and abruptness, and the higher the need for achievement in an individual, as all measured by the Occupational Stress Indicator (OSI) subscales, the more the individual is

likely to have less stress, anger, frustration and helplessness, and report higher levels of perceived control, as measured by the subjective ratings after computer sessions.

Given the inverse relation between computer attitude and subjective ratings (CPTOT), this result was indirectly supported by the significant association between higher levels of A Typology (BRVIEW and OSITOT) and more positive computer attitude (CAS and DCAS).

However, this result was not supported by any other correlation finding. No significant (cor)relation was found between subjective ratings and total Type A score (OSITOT) or style of behaviour (STY). And no significant relation was found between stress before or after computer sessions (as measured by SACL) and any of the A typology (sub)measures.

Similarly to previously examined variable of computer anxiety, this result seemed to contradict Hart et al's findings (1987) that Type As may exhibit more stress than Type Bs. It also contradicted the more general literature on the Type A personality construct (e.g. Kobasa, 1988) suggesting that Type As would be more prone to stress and anxiety (as well as anger, frustration, and helplessness) because of their general competitiveness, achievement striving, time urgency, impatience and hostility. The present results also indirectly negated Van Dijkhuizen and Reiche's (1980) finding that Type As exhibit more psychological complaints.

In addition, the lack of any significant correlation between 'stress before', 'stress after' (as measured by SACL), and A typology may lead to the assumption that it is not specifically 'stress' the variable which was found to (cor)relate with type A personality construct, but stress in combination with other related concepts, such as anger, frustration, helplessness, etc. As mentioned before, in the post-session subjective ratings of the previous chapter, high frequencies of responses were found for questions referring to anger and frustration. This result suggested that a hint of bias reflecting impatience was detected as a characteristic of the mood and the feelings of subjects after computer interaction. It was then thought that Type A individuals may have been irritated by slow responses of machines. However, the present findings clearly contradicted assumptions as this, since Type A subjects were found to experience less anger and frustration, as reported after each of the sessions with the computer.

The present results found some relation between A typology and stress, anger, and other related feelings, but inversely than expected according to the most widely accepted conceptualisations and measurements of A Typology. However, as previously discussed, most difficult to the personality and stress/anxiety researcher are the many pending questions about what Type A is, and what psychological processes underlie it. And it may also be that the OSI is not an adequate measure of A typology.

3. The third research question here was: Does A Typology relate to a) computer performance and b) subjective difficulty in computing tasks? And if so, do performance and difficulty correlate positively or negatively with A Typology?

A. Performance

There was no significant association between A Typology and performance on computing tasks. This result suggested that a person's computer performance has nothing to do with their A Typology behaviour pattern.

Similarly to previously examined variables, this result fails to confirm Hart et al's findings (1987) that Type As achieve better performance than Type Bs. It also contradicted some of the more general literature on the Type A personality construct (e.g. Kobasa, 1988) suggesting that Type As would perform better than Type B's on anything because of their general competitiveness, achievement striving, ambition, higher self-esteem, ever-increasing expectations of personal productivity, commitment, confidence, and dedication.

The assumption, that impatient high scorers in A typology may have been irritated by slow responses of machines, and that this may have influenced their performance negatively was also clearly contradicted by the present findings, since A typology did not correlate with performance. Thus, a possible hypothesis that the impatience aspect of Type A subjects might affect performance in computing was not upheld.

B. Subjective difficulty

The only significant association found between A Typology and subjective difficulty was that higher levels of A Typology, as measured by the 'Broad view of Type A' subscale (BRVIEW), were associated with lower levels of subjective difficulty (SUBJLOG). Higher scorers of A typology were found to experience or perceive less difficulty, as reported after each of the sessions with the computer. This result suggested that a person's experienced difficulty when completing various computing tasks have at least some relation to their A Typology behaviour pattern, in that the higher the Type A pattern the less the difficulty.

However, this result was not supported by any other correlation findings. No significant (cor)relation was found between subjective difficulty and total Type A score (OSITOT) or style of behaviour (STY).

On the other hand this finding may not be as clear as it looks. The present results may be interpreted as confirming Hart et al's findings (1987) where evaluations given by Type As and Type Bs may not have been equally reflecting and representative of their experiences. In particular, in Hart et al's 1987 study, Type As appeared to be less sensitive to the effort they exerted to achieve their scores. Also, Type As' physical and mental effort subscale

ratings were found to be lower, and Type As reported similar levels of fatigue, even though they appeared to have been working harder than Type Bs, according to the number of function key-actuations that they made.

Since, in Hart's study, Type As and Bs were not equally accurate in evaluating computer task-related and operator-related aspects of their experiences, then, within the present study, one possibility is that subjects scoring higher in A typology tended to underestimate the difficulty they experienced while completing series of computer tasks; hence, the correlation found between the A typology and the subjective difficulty variables.

Furthermore, some of the personality characteristics attributed (within the relevant literature) to Type A subjects, such as higher self-esteem, commitment, confidence and dedication, may, to a certain extent, have contributed in reducing the perceived difficulty experienced while completing or attempting to complete different computing tasks. However, no relationship was found between the total score of Type A (OSITOT) or style of behaviour (STY) and subjective difficulty; but this may have been again because of the general possible inadequacy and low reliance of the OSI.

So, the present results did not find any relationship between the Type A typology and performance, but found some relationship between A typology and experienced difficulty when dealing with a number of computer tasks. It could be noted once more, that in considering reliance of the Type A personality construct and Cooper et al's measure, further research should investigate different conceptualisations and measurements not only of the Type A construct but also of computer performance and perceived difficulty. Further research should also consider the particular relationship of the cognitive, behavioural and ambition components of A Typology, to different measures of performance and difficulty, as indicated by subjective, behavioural and/or physiological measures.

III. Neuroticism

1. The first research question here was: Does neuroticism (instability) relate to attitudes (including anxiety) towards computers? And if so, do computer attitudes correlate positively or negatively with neuroticism?

The present results showed a significant association between higher levels of neuroticism, as measured by the EPI subscale, with higher levels of computer anxiety and lower levels of computer confidence (CAS). This result was supported by the significant association between higher levels of neuroticism (INSTAB) with more negative computer attitude, as measured by the DCAS. However, no significant correlation was found between neuroticism and the 'computer liking' (CAS) attitude variable.

Within the aims of this study, it was discussed that the relationship between 'trait anxiety' and 'neuroticism' is so close and their correlation so high that some researchers treat them as terms describing the same or at least similar concepts (e.g. Cattell and Scheier, 1958). Also, it was suggested that computer anxiety may be seen as a 'state' type of anxiety (see General Introduction).

Furthermore, Themes (1982) and others (e.g. Betz, 1978; and Rounds and Hendel, 1980) have found that trait anxiety was a significant correlate of maths anxiety. For this reason, trait anxiety has been studied by Howard (1984, 1986) and Raub (1981) as a possible correlate of computer anxiety. The reasoning was that high trait-anxious individuals could be expected to exhibit state-anxious elevations (such as computer anxiety) more frequently than low trait-anxious individuals (e.g. Naylor and Guardy, 1973).

Raub found a 0.32 correlation ($p < 0.001$) in males between trait anxiety and computer anxiety. The researcher measured trait anxiety using the trait portion of the State Trait Anxiety Inventory (Spielberger, Gorsuch, and Lushene, 1970), a 20-item 4-point Likert scale. Construct validity for this instrument has been established by correlations with other measures of trait anxiety or neuroticism including EPI, the IPAT Anxiety Scale (Cattell and Scheier, 1963), the Taylor Manifest Anxiety Scale (Taylor, 1953), the Zuckerman Affect Adjective Checklist (AACL, Zuckerman, 1960), etc.

The results of the present study seem to confirm previous findings by Raub and Howard that neuroticism or trait anxiety are significantly (cor)related with computer attitudes and computer anxiety. The present results also seem to indirectly support Wankowski's (1973) findings that low neuroticism students preferred practically biased courses, whereas high neuroticism students opted for people-oriented courses, as computing may be seen as a practical rather than a people-oriented activity. Similarly, the present results may be interpreted to support Bendig's (1963) findings that high neuroticism was associated with a dislike of business-type occupations, such as banking, office management, and accountancy. In this context, computers and computing may be seen as rather closely related to business-type and office management occupations and activities.

In addition, it seems that the findings of the present study confirm the more general literature on neuroticism personality trait suggesting that neurotic or high-trait anxious individuals would be more prone to any type of state anxiety, including computer anxiety, because of their general fluctuations of mood, negative thinking and negative interpretation of events in their lives, easily hurt feelings and feelings of guilt, irritability and anticipation of the awful, all as described and assessed by the EPI.

The present findings also seem to confirm the previously discussed research which suggests that a positive attitude towards computers is inversely related to computer anxiety (e.g. Gressard and Loyd, 1986), while specific anxieties tend to be related to trait anxiety and to the underlying personality dimension of neuroticism (Francis, 1993). These relations suggest a negative correlation between neuroticism and computer-related attitudes. Although this hypothesis is supported by the findings of Sigurdsson (1991), Katz and Offir (1991) and Katz (1993), it is not, however, supported by Egg and Meschke (1989), by Katz and Francis (1995), or by Francis (1995) except in relation to the specific construct of computer anxiety.

On the other hand, the present results negated Francis et al's (1996) findings, where the absence of a significant correlation between neuroticism scores and attitude towards computers did not support the hypothesis that a more positive attitude towards computers is inversely related to neuroticism or anxiety. Francis et al's findings were also supported by Katz and Francis (1995) and by Francis (1995). However, the present results confirmed Sigurdsson (1991), Katz and Offir (1991) and Katz (1993) who found a significant negative relation between neuroticism and computer-related attitudes.

Finally, in considering the present results, it should be noted that the correlation between neuroticism and computer anxiety seems to be surprisingly low (-0.24). This finding may suggest that computer anxiety is **not** simply an exhibition of neuroticism or trait anxiety.

2. The second research question was: Does neuroticism (or instability) relate to stress before and after computer sessions? And if so, does computer stress correlate positively or negatively with neuroticism?

The present results showed a significant association of higher levels of neuroticism (EPI) with higher levels of stress before and after computer interaction (as measured by SACL). This result was supported by the highly significant correlation finding that the higher the subjects' neuroticism the higher the computer stress, anger, frustration and helplessness as indicated by the subjective ratings (CPTOT).

These results suggested that a person's experienced stress before and after computer interaction, as well as related concepts such as anger, frustration and helplessness experienced after computer interaction have a close relation with his/her neuroticism personality characteristic. In particular, and as expected, the higher the neuroticism the more the individual is likely to experience more stress before, and more stress, anger, frustration and helplessness, after computer sessions, as indicated by Cox's measure and the subjective ratings.

Similarly to previously examined variable of computer anxiety, this result seemed to confirm Raub's (1981) and Howard's (1984, 1986) and indirectly support Wankowski's (1973) and

Bendig's (1963) findings. It also seemed to indirectly agree with the more general literature on the neuroticism construct, suggesting that neurotic individuals would be more prone to stress and anxiety (as well as anger, frustration and helplessness) because of their general predisposition to any kind of anxiety and more psycho-physiological complaints, as described and assessed by the EPI.

The positive correlation of neuroticism (INSTAB) with the post-session subjective ratings (CPTOT), and the previous chapter finding, that anger and frustration were high frequency responses, may lead to the assumption that high levels of neuroticism were particularly exhibited with high levels of anger and frustration when dealing with computer tasks.

Thus, the present results indicated a close relationship between the neuroticism trait and computing related stress. There is not any known previous research on computer stress, in relation to neuroticism. As quite a lot of reliance can be placed on EPI and SACL measures, the present results can lead to the conclusion that there is a close relationship between computer stress and neuroticism, followed by the assumption that neuroticism, similarly to trait anxiety, can 'make' (neurotic) individuals prone to high computer stress and anxiety (as well as anger, frustration etc) when completing various computing tasks. Additional research should further address this issue by conducting, for example, a similar study which would involve different computing situations and tasks.

3. The third research question here was: Does neuroticism (or instability) relate to a) performance and b) subjective difficulty in computing tasks? And if so, do performance and difficulty correlate positively or negatively with neuroticism?

A. Performance

There was no significant association between neuroticism (INSTAB) and performance (ARCSPERF) on computing tasks. This result suggested that a person's computer performance has nothing to do with their neuroticism personality trait.

As findings about the relationship between neuroticism and computer performance hardly exist in the literature, there is no way of comparing the present results to any previous findings. However, the present results may have contradicted an 'intuitive' speculation that performance should inversely correlate with neuroticism, and neurotic individuals are likely to perform worse than stable ones because of their negative thinking and feelings which may contribute in inhibiting their respective performance.

B. Subjective difficulty

The present results showed a significant association of higher levels of neuroticism (EPI) with higher levels of subjective difficulty (SUBJLOG). This result suggested that a person's

experienced difficulty during completion of various computer tasks, as self-reported after computer interaction, **does** relate to his/her neuroticism trait, in that the higher the neuroticism the lower the difficulty.

This result may be interpreted as confirming the 'intuitive' speculation that neurotic individuals would find computer tasks more difficult than stable subjects due to their presumably negative way of appraising the difficulty involved in the completion of these tasks.

As with Type As and Bs, neurotic and stable individuals may have not been equally accurate in evaluating computer task-related and operator-related aspects of their experiences, within the present study. One possibility is that subjects scoring higher in neuroticism tended to exaggerate the difficulty they experienced while completing series of computer tasks; hence, the negative correlation between neuroticism and the subjective difficulty variables.

So, the present results did not find any relationship between neuroticism and performance, but found some relationship between neuroticism and experienced difficulty when dealing with a number of computer tasks. Since EPI is a well established measure of neuroticism, further research should investigate the relationship between neuroticism, as measured by the EPI, and different levels of performance and difficulty, as defined and assessed by different conceptualisations and measurements.

IV. Extraversion

1. The first research question here was: Does extraversion relate to computer attitudes, including computer anxiety? And if so, do computer attitudes correlate positively or negatively with extraversion?

The only significant finding here was the association between higher levels of extraversion, as measured by the respective EPI subscale, with lower levels of computer anxiety (as measured by CAS). No (cor)relation was found between extraversion and any of the remaining (CAS or DCAS) computer attitude variables.

This result suggested that a person's computer anxiety, as part of their computer attitude, is closely related to their extraversion personality pattern. In general, the higher the extraversion, (defined by Eysenck and other writers as involving sociability, frequent need for people and excitement, spontaneity, practical sense of humour, optimism, etc) the lower the levels of computer anxiety (and thus the more positive the computer attitude).

The present findings seem to contradict the previously discussed research which suggested a negative correlation between extraversion and computer-related attitudes. This research argues that a positive attitude towards computers may reflect a preference for solitary activities and an avoidance of social interaction (Alspaugh, 1972), while extraversion is clearly characterised by

sociability, a preference for group activities and an avoidance of solitary activities (Eysenck and Eysenck, 1975). These relations suggest a negative correlation between extraversion scores and computer-related attitudes. This is consistent with Bozeman's (1978) findings which reported some degree of relation between extraversion and apprehension of computer technology, and with Katz and Offir's (1991) findings. On the other hand, Egg and Meschke (1989), Sigurdsson (1991), Katz and Francis (1995), Francis (1995), and Katz (1993) found neither a positive nor a negative relation between extraversion and attitude towards computers.

Furthermore, the present results negated Francis et al's (1996) findings, where more positive attitudes towards computers were associated with lower scores on the extraversion scale, and, thus, introverts were found to have a more positive attitude towards computers than extraverts. In Francis et al's study, the significant negative correlation between extraversion scores and attitude towards computers lends support to the hypothesis that a more positive attitude towards computers may be positively related to a more general tendency to prefer solitary activity and to avoid social activities. This conclusion was also supported by Katz and Offir (1991), although not by Sigurdsson (1991), Katz (1993), Katz and Francis (1995) and Francis (1995) who found no relation between extraversion and computer attitudes.

The present results found extraverts to have a more positive attitude towards computers than introverts rather than the reverse or no relation.

Although this result negates much of the relevant literature, it may be interpreted as indirectly confirming some of the general literature on extraversion. For example, previous findings by Wankowski (1973) suggested that extraverted students tended to choose practical or people-oriented courses, whereas introverted students preferred more theoretical subjects. In this context computing may be seen as a practical rather than a people-oriented activity.

In conclusion, it seems that further studies are needed using other indices of computer-related attitudes and conducted among other samples in order to clarify the conditions under which the hypotheses linking personality and computer-related attitudes hold good and the conditions under which they do not hold good.

2. The second research question here was: Does extraversion relate to stress before and after computer sessions? And if so, does computer stress correlate positively or negatively with extraversion?

The present results showed a significant association of higher levels of extraversion with lower levels of computer stress experienced before computer sessions ($r = -0.16$).

Since computer stress (especially as experienced in anticipation - before computer interaction) is conceptually close to computer anxiety, as previously shown, the correlation between

extraversion and computer stress could be interpreted in similar terms with those of computer anxiety, as previously discussed.

3. The third research question here was: Does extraversion relate to a) performance and b) subjective difficulty in computing tasks? And if so, do computer performance and difficulty correlate positively or negatively with extraversion?

A. Performance

There was no significant association between extraversion (EXTVER) and performance (ARCSPERF) on computing tasks. This result suggested that a person's computer performance has nothing to do with their extraversion personality trait.

Although the difference in the computing activities involved, the present result seems to be similar with some of the previously discussed research. In particular, Chin and Zecker (1985), Kagan and Douthat (1985), and Newsted (1975) found no relation between extraversion and computer programming achievement or success. However Kagan and Esquerra (1984) found that extraversion was negatively correlated with achievement in computer programming exams – a finding that seems to contradict the present results.

The present results seemed to also negate some of the more general literature. For example, Wankowski (1973) found that introverted students had greater examination success than extroverts in the physical sciences. In addition, the present results appeared to contradict Kim's (1980) findings that there was a significant difference between introverted and extroverted students in actual performance.

Furthermore, a possible hypothesis, that the introverts' personality characteristics (for example, being quiet, reserved, tidy-minded, well ordered and well organised) may affect positively their computer performance, was not upheld.

In general, the differences in sample sizes, the varying results, the different computing activities involved, the different instruments used and the varying context prevent one from making any definite or reasonable conclusion regarding the relation between personality characteristics (e.g. extraversion) and computing related variables (e.g. computer performance).

B. Subjective Difficulty

The present results showed no association between extraversion (EXTVER) and subjective difficulty (SUBJLOG). This result suggested that a person's experienced difficulty during completion of various computer tasks, as self-reported after computer interaction, does not relate to their extraversion trait, as measured by the EPI.

In conclusion, the present results did not find any relationship between either extraversion and performance or extraversion and experienced difficulty. As before, since EPI is a well established measure of extraversion, further research could investigate the relationship between extraversion, as measured by the EPI, and different levels of computer performance and difficulty, as assessed in different tasks, within different contexts and by different measures.

V. General (Multiple Regressions)

The last question specified in the aims of the present chapter was:

Does information on personality types / variables (i.e. locus of control, type A, extraversion, and neuroticism) add or contribute anything to the variance of computer stress and performance, over and above initial computer attitudes?

In order to answer this question, a number of multiple regression analyses were conducted to look at the contribution of the personality and attitude variables to the outcome. For each of the regressions, the dependent variable was one of the following: performance (ARCSPERF), subjective difficulty (SUBJLOG), stress before computing sessions (STRBEF), stress after computing sessions (STRAFT), or the subjective ratings indicating stress, frustration, anger, etc, after computer sessions (CPTOT).

The independent variables for each of the regressions were some of the dimensions of each of the locus of control scales [Levenson's Internal (INT) and Chance (CH), and Paulhus' Personal (PERS) and Interpersonal (INTPERS) control], EPI's neuroticism [or instability (INSTAB)] and extraversion (EXTVER), OSI's Broad View of Type A (BRVIEW), and the CAS' attitude dimensions of (initial) computer anxiety (CANX1) and confidence (CCON1).

From the multiple regression of performance upon personality and attitude variables, it was found that the main, although weak, personality predictors of computer related performance were Internality and Chance dimensions of locus of control, as measured by Levenson's scales (together accounted for 8% of the variance in performance); computer confidence, as measured by CAS, was to a lesser extent predictor of performance. This suggested that the more internal the subjects' locus of control was and the less their belief that chance controls their lives, the better the performance they were likely to achieve on various computer tasks. Although causality cannot be established, internality of locus of control appears to be the key variable in determining computer performance.

When the 'experience' (D4) dummy variable was added to the independent variables, results were the same, and experience was found to be irrelevant with computer performance.

The multiple regression of subjective difficulty upon personality and attitude variables showed that the main predictor of computer related difficulty was again mainly

confidence, and to a much lesser extent 'chance' as measured by Levenson's (sub)scale. Confidence accounted for about 19% of the variance in subjective difficulty. This suggested that the more the computer confidence the subjects had, the less the difficulty were likely to experience when completing various computer tasks. Although again causality cannot be easily established, computer confidence appears to be the key attitude variable in determining subjective difficulty.

When the 'experience' (D4) dummy variable was added to the independent variables, results were the same; experience did not enter the regression equation and thus was found not to contribute anything in predicting subjective difficulty.

The multiple regression of 'stress before' upon personality and attitude variables showed that the main personality predictor of computer related stress before computer interaction was computer anxiety, accounting for about 14% of the variance in initial stress. Neuroticism (or instability) was to a lesser extent a predictor of 'stress before'. This suggested that the more the subjects' computer anxiety and neuroticism the more the stress they were likely to experience before completing various computer tasks. In other words, mainly state (computer) anxiety but also trait anxiety appear to be the key variables in determining stress before computer interaction.

When the 'experience' (D4) dummy variable was added to the independent variables, experience **did** enter the regression equation. It was found that experience contributed minimally to the model (about 2%) and thus had a small effect in predicting stress before computer interaction.

The multiple regression of 'stress after' (as measured by SACL) upon personality and attitude variables showed that the main personality predictor of computer related stress after computer interaction was computer confidence (accounted for about 16% of the variance in 'stress after'). Neuroticism (or instability), as measured by the EPI, and chance, as measured by Levenson, were to a lesser extent predictors of 'stress after'. This suggested that the more the subjects' confidence and the less the neuroticism, the more the stress they were likely to experience after completing various computer tasks. Mainly confidence but also neuroticism appear to be the key variables in determining stress after computer interaction.

When the 'experience' (D4) dummy variable was added to the independent variables, experience did not enter the regression equation and added nothing to the variance of 'stress after'; thus, it was concluded that stress after computer interaction was not a function of experience.

The multiple regression of subjective ratings upon personality and attitude showed that the main and strong predictor of computer related stress, anger, helplessness, frustration, (as

reported after computer sessions) was computer confidence. Confidence accounted for a 47% of the variance in subjective ratings. Interpersonal control (as measured by Paulhus) and internality (as measured by Levenson) were to a much lesser extent predictors of stress, anger, etc after computer interaction. This suggested that the more the subjects' computer confidence, the less the stress, anger, etc the subjects were likely to report after completing various computer tasks. In the main, computer confidence appears to be the key variable in determining stress, anger, etc reported after computer interaction, as measured by the subjective ratings.

When the 'experience' (D4) dummy variable was added to the independent variables, as before, experience did not enter the regression equation and added nothing to the variance of the subjective ratings. It was concluded that stress, frustration, anger, etc as reported after computer interaction was not a function of experience.

In summary, the main points of the regressions are:

- a) Computer confidence is the main and strong predictor variable in determining subjective ratings, the main variable in predicting 'stress after', the key variable in predicting subjective difficulty, and a contributing variable in predicting performance. It is only where the dependent variable is 'stress before' that computer confidence does not contribute anything to the outcome.
- b) Computer anxiety is the key predictor of 'stress before'; however, it does not add anything to the variance of any other dependent variable.
- c) Levenson's internal locus of control is the main, although weak, predictor of performance, and slightly contributes to the outcome of subjective ratings.
- d) Levenson's 'chance' is a major but weak predictor of performance, and slightly contributes to subjective difficulty and SACL's 'stress after'.
- e) Neuroticism (or instability) is a considerable contributor to the outcome of 'stress before', and accounts for a small proportion of the variance of 'stress after'.
- f) Paulhus' interpersonal control slightly contributes to the outcome of the subjective ratings.

Note that Appendix Thirteen provides an update of current related research and a summary of recent supplementary information.

Appendix Fourteen provides a schematic overview of results within the literature on the relationships of computer attitudes to stress, performance, prior computing experience and four personality variables. This is accompanied with a narrative account describing the variables examined and associations found in the literature – including theoretical and statistical commentary.

Appendix Fifteen provides a schematic overview of results of the present research on the relationships of computer attitudes to stress, performance, subjective difficulty, prior computing experience and four personality variables. This is accompanied with a narrative account describing the variables examined and associations found in the present research – including theoretical and statistical commentary. The findings are set in the context of the literature.

CHAPTER FIVE

General Discussion

1. Summary of findings

Generally, the present work was concerned with the initial attitudes of users towards computers, the relation of these initial attitudes to prior experience, as well as the relation of these attitudes to stress, performance and the personality of the user. It also looks at the extent to which changes come about as the result of experience gained from a type of computer course. The extent to which individuals found computing stressful was investigated. Studies were conducted employing questionnaire methods to provide data over a three year period.

In Chapter Two, the change of attitudes in relation to experience gained from a computer course, as well as the effects of prior experience on initial attitudes and attitude change were studied. The main hypothesis was that computing experience would improve attitude scores. It was found that subjects with the greatest initial computer experience did indeed have more positive initial attitudes. However, attitude scores were significantly decreased over a period of the computer course (a few months) rather than improving. Thus, while high levels of prior experience had a positive effect on initial attitude, subsequent experience (the introduction of a 'new' computer system) had a negative effect, in that the higher the prior computer experience the more the decrease of attitudes towards computers over the period of the computer course.

In Chapter Three, computer stress, the impact of computing experience on computer stress and performance, as well as their relation to computer attitudes, were examined. Computer stress was assessed before and after computer interaction on several occasions. Performance and (subjective) difficulty at the computer were also assessed after each terminal session. Alternate hypotheses were that computing experience might either increase or decrease subjects' stress scores. It was also hypothesised that subjects with greater initial experience and more favourable attitudes towards computers would feel less stress before and after computer sessions, as well as perform better and experience less difficulty on various computer tasks.

It was found that subjects' stress scores increased from before to after computer sessions transiently, i.e. only for the first week's session, and mainly due to the more experienced users. Also, subjects with greater initial computer experience and more positive attitudes towards computers had less stress before and after computer sessions. However, the results showed that there was no effect of computer experience on computer performance. And there was some effect of experience on subjective difficulty, mainly, again, due to the effects of the more experienced computer users.

Correlations showed that more favourable computer attitude, lower levels of computer anxiety, more computer confidence and liking were strongly associated with lower levels of stress experienced before and after computer sessions and with lower levels of subjective difficulty. Also, to a lesser extent, more positive computer attitude, as indicated by all attitude measures, was associated with better computer performance.

A series of multiple regressions of computer attitudes on stress and performance indicated that the main attitudinal predictor of stress experienced after computer sessions was computer confidence, whereas the key predicting variable of stress experienced before computer sessions appeared to be computer anxiety. Computer confidence seemed to be a weak predictor of performance, but really no attitudinal variable predicted performance adequately. When computing experience was added to the independent variables, it slightly contributed in predicting only stress before computer sessions.

In general, prior computer attitudes were found to relate to stress experienced in a computing session. And, although all attitude variables correlated with all stress variables, it was mainly computer confidence that accounted for most of the variance in the stress variables. And, in terms of regression, while computer anxiety seemed only to relate with anticipation of a computing situation, computer confidence appeared to relate with dealing with the computing situation.

In Chapter Four, computer attitudes, stress, performance, and experience were examined in relation to personality variables of locus of control, extraversion and neuroticism, as well as A typology. Locus of control was assessed by using two measures: the Levenson's locus of control scale (Levenson, 1974) and Paulhus' spheres of control inventory (Paulhus, 1989).

The correlations between each of the personality constructs with initial computer attitudes, three indices of stress, performance, subjective difficulty and prior experience were examined. The main research questions were: 1) Is locus of control related to computer attitudes, stress, and performance? And if yes, is it internality or externality of locus of control that correlates positively with those variables? 2) Are A typology, extraversion, and neuroticism constructs (cor)related with computer attitudes, stress and performance; and if yes, how? And 3) What is the relative contribution (if any) of personality variables to the variance of computer stress and performance, over and above initial computer attitudes?

In terms of Paulhus' spheres of control inventory, it was internal personal and interpersonal locus of control that were found to be associated with more favourable attitudes towards computers (lower levels of anxiety and higher of confidence), and lower levels of stress both before and after computer sessions. However, the results showed that there was no relation

of locus of control (as measured by Paulhus) with computer performance; and only internality of interpersonal control was related to perceived difficulty – albeit weakly.

In terms of Levenson's locus of control (sub)scales, it was mainly lower levels of belief in chance that was found to be associated with less computer anxiety (and thus more favourable attitudes towards computers), lower levels of stress before and after computer sessions, and lower levels of subjective difficulty. However, belief in chance was not related to performance. In addition, to a lesser extent, internality was found to be associated with lower stress levels after computer sessions, better performance, and less subjective difficulty. Finally, lower levels of belief in powerful others as life's major controlling force were found to be weakly associated with better computer performance. In general, findings derived from Levenson's locus of control measure went in the same direction as the ones derived from Paulhus' SOC.

A series of multiple regressions at this point indicated that when each of Levenson's and Paulhus (sub)scales, together with (prior) computing experience, are regressed on each of the computer attitude variables, then, in all cases, experience explains more variation in attitudes than locus of control. In particular, the main predictors of computer anxiety and confidence were computing experience, Levenson's belief in chance and Paulhus' personal control. The main predictor of computer liking was computing experience only. And the key predicting variables of general computer attitude, as indicated by DCAS, were experience, Levenson's internality, and Paulhus' personal control. However, in all the cases above, the predictors did not explain much of the variance in the attitude variables.

Higher A typology was generally found to be associated with more positive attitudes towards computers, more confidence, and lower levels of anxiety, stress and subjective difficulty. No relation was found between A typology and performance.

Higher levels of neuroticism (or instability) were associated with less favourable attitudes towards computers, less confidence, and higher levels of computer anxiety and stress before and after sessions. Neuroticism was also found to relate weakly with higher levels of subjective difficulty, but was not found to relate with performance.

Finally, extraversion was found to be relatively unimportant, although higher levels were associated with lower levels of computer anxiety and stress before sessions.

A series of multiple regressions of personality and attitude variables together on stress and performance indicated that the key predicting variables of computer related stress before sessions were computer anxiety, and to a lesser extent EPI's neuroticism, whereas the predicting variables for stress after computer sessions were confidence and to a lesser extent EPI's neuroticism and Levenson's chance. Predicting variables of subjective ratings (CPTOT), reported after computer sessions, were mainly computer confidence, and to a lesser extent

Paulhus' interpersonal control and Levenson's internality. Also, the main, although weak, predictors of computer related performance were Levenson's internality, chance and to a lesser extent confidence. However, the main predictors of subjective difficulty were found to be mainly computer confidence, and to a lesser extent Levenson's chance. When computing experience was added to the independent variables, it contributed slightly only to stress before computer sessions and to none of the other outcome variables.

Note that Appendix Fifteen provides a concise schematic overview of the relationships found between the different variables in the present research.

2. Origins of computer attitude and anxiety

It was suggested in the first chapter that computer anxiety and negative attitude have 'psychological' (or personality), educational, and operational roots/origins (e.g. Raub, 1981; Howard, 1984, 1986). Thus, when a computer anxious individual interacts with a computer, he/she may experience fear as related to three different origins: 1) the operation of the computer's keyboard, disk drives and/or other parts (operational origin); 2) the operator's possible inability to make the machine perform as desired because of lack of computer skills, and/or inability to understand why the machine 'behaves' as it does, because of general or specific computer knowledge (educational or knowledge-based origin); 3) the operator's personality characteristics that may result in negative reactions to the computer ('psychological' or personality origin).

Weinberg (1983) attempted to verify the 'state' nature of computer anxiety, by using physiological measures. In considering his views, operational computer fears may be rather 'state' than 'trait'. They also appear to be easier to 'diagnose' and 'treat', compared to educational and personality originated fears; i.e. enough experience can be provided in order to reduce any operational concerns. Educational fears may be in the middle between the 'state' and 'trait' characteristics and could be regarded as more persistent. They could be more difficult to alleviate than operational fears, and may be alleviated only when the needed computer knowledge is obtained. Finally, 'psychological' fears may be rather 'trait' than 'state', more persistent than educational, and the hardest ones to understand and treat because treatment may require major changes in some of the person's personality characteristics. These characteristics may 'make' a person more prone to anxiety and negativity than others towards computers in particular and technology in general (e.g. Weinberg, 1983; Howard, 1984, 1986). According to this discussion, probably only 'psychological' fears may be considered as the 'trait' part of computer anxiety.

It should be noted, that the term 'trait' here will be used to reflect the usage in the computer anxiety literature without endorsing the strong use of the term by researchers such as Eysenck.

Operational origins: Computer experience

In considering the operational fears, there was some evidence within the present research that may provide some clues about the nature of computer anxiety, attitude and stress.

In particular, within chapter two, it was found that a lot of prior computing experience (for example programming) was a good predictor of initial attitudes (as measured by CAS and DCAS), including anxiety, confidence and liking: high levels of experience were associated with more positive initial attitude. And within chapter three, it was found that a lot of prior experience showed a significant impact on stress before computing sessions, in that the higher the experience the lower the initial stress levels. A lot of prior experience showed similarly a significant impact on stress after sessions, but only in contrast to no prior experience. The effect of 'medium' experience on stress after computing sessions, however, was not significantly different than the impact of 'high' experience. (Also, the finding that a lot of prior experience also had a significant impact on subjective difficulty may indicate that there is at least some indirect relation between computer stress and the experienced difficulty when completing various computer tasks during computing sessions.).

The above results regarding computing experience are consistent with Raub's result for a sample of college students; Raub (1981) found that computer anxiety significantly correlated with computer experience at -0.47 for males and -0.43 for females. The present results also confirm most of the subsequent research, that generally demonstrates that prior experience with, or exposure to, computers is positively related to attitudes (e.g. Badagliacco, 1990; Koohang, 1989; Lever et al, 1989, Woodrow, 1994, etc). In addition, the present findings also seem to confirm research studies that demonstrate that computer experience – both the type as well as the amount – is associated with lower levels of computer anxiety (e.g. Dyck and Smither, 1994). These findings suggest that experience with computers lead to positive attitudes towards them, and to a reduction in anxiety related to present or future use of computers.

Furthermore, the present research seem to confirm studies that have directly related subjects' reported prior amount and/or type of computer experience with their attitude and/or anxiety scores. These studies, as reported in the first chapter, have found a positive relation between computer attitude and amount of prior computer experience, and a negative relation between computer anxiety and computer experience (e.g. Levine et al, 1997, 1998; Levin and Gordon, 1989; Koohang and Byrd, 1987; Loyd, Loyd, and Gressard, 1987; Todman and Monaghan, 1994; Maurer, 1994; Rosen and Weil, 1995; Mahmood and Medewitz, 1989; Jay, 1985; Ray and Minch, 1990; Marcoulides, 1988; Heinssen et al, 1987).

In support of this, it makes good intuitive sense that the more the computer experience a person has, the less anxiety and difficulty he/she is likely to experience in anticipation or in

actual operation of a computer;. thus the lower will be the level of the negative reaction arising from computer operational problems. The close relation between experience, computer anxiety and stress before and after sessions, derived from ANOVAs, correlations and multiple regressions, has further confirmed that.

The finding that computer experience relates a lot (and may also relate causally) to computer anxiety, computer stress, and computer attitudes, supports the idea that computer operational problems are at least part of the source of negative reactions to computers. Besides, in practical terms, experience is fairly easy to increase for most individuals [exceptions may be found among computerphobics; e.g. Marcoulides, 1988; Brosnan, 1998)]; thus, the operational roots of computer stress, anxiety, and attitudes may be seen as fairly easy to treat and modify.

It should be noted though that the possibility exists of a 'sampling' effect, such that those with initially more positive attitudes to computing gain more experience, while those who dislike computers do not persevere. Subsequently it would then appear as if those with greater experience have less anxiety, but it may be that those with less anxiety have gained more experience.

However, according to the present findings, conclusions appear to be different when changes in computer attitude and anxiety levels, as a consequence of completing some type of computer course, are considered and measured. The present study is unusual in having looked at both these aspects of experience.

In particular, according to the present findings, a lot of prior experience was a good predictor of the **decrease** of confidence and liking from Test 1 (at the beginning of each academic year) to Test 2 (at the end of each academic year). However, the impact of 'high' level of experience on computer anxiety increase was only of a statistically marginal significance. 'Medium' (for example word processing) experience was a good predictor of the **decrease** of computer liking and the DCAS scores. Computer games experience only was similarly a predictor of the decrease of computer liking. Finally, no prior experience was related with a decrease of means in computer anxiety – although this change was not found to be statistically significant. Also, within chapter three, a lot of prior experience was a predictor of the increase from stress before to stress after sessions. However, this finding was statistically significant only for the first week's session.

It would generally appear that, when changes in computer attitude and anxiety levels are considered as a consequence of completing some type of computer course, then the higher the prior computing experience, the greater the shift of the attitudes to be less favourable. However,

this result does not appear to be as clear in the case of computer anxiety and computing related stress.

The present findings seem to contradict much of the relevant literature where a substantial number of pre-test/post-test studies report a positive relation between computer attitude and computer experience gained from some type of computer training course, and a negative relation between computer anxiety and computer experience gained from some type of computer training course (e.g. Harrington et al, 1990; Czaja and Sharit, 1998; Brown and Coney, 1994; Woodrow, 1994; Gressard and Loyd, 1985; Igarria and Chakrabarti, 1990). However, the findings of these studies are by no means universal. For example, Rosen et al (1987) found that computer anxiety did not decrease with computer experience gained from some type of computer training course, and at times actually increased; a result that seems to support the present findings. In contrast, while both McInerney et al (1994) and Leso and Peck (1992) found that computer anxiety generally decreases with experience, they also found that high levels of computer anxiety persist in some individuals despite training. Similarly, Koslowsky et al (1987) found no improvement in students' computer attitude, and Temple and Gavillet (1990) found no decrease in older novice users' computer anxiety as a function of training. Moreover, Chu and Spires (1991) showed that a computer course may be an appropriate method to reduce computer anxiety, but only for some cognitive styles. Finally, while Lambert (1991) found a relation between computer anxiety and computer experience, those subjects with initially low levels of computer anxiety experienced increased levels of state anxiety when faced with a novel task.

Thus, when computing experience comes from some type of computer course, with a pre-test and post-test measurement of attitude and anxiety, then the relation between computer attitude/anxiety and computer experience seems to be more complex than a general reduction in anxiety and improvement of attitude with experience.

Present data indicate that pre-test/post-test change of attitude may be sensitive to degree of prior experience. The current study actually found a decrease of attitude in all (according to their prior experience) but naïve users (where means actually increased – though this was not significant). The greatest decrement occurred in the most experienced users. It may also be that some of the differences in literature relate to variations in prior experience. A similar to the present study, where a bigger sample of naïve users are involved, could possibly clarify further the effect of prior experience on pre-test/post-test change of attitude.

In summary, the present findings suggest that although high levels of general prior experience relate to more positive attitude and lower levels of computer anxiety, experience gained from a structured computer course seems to relate to a decrease of computer attitude and have no clear

effect on (if not increase) computer anxiety. It seems also that the higher the levels of prior experience the more the negative impact of a computer course on attitude (decrease).

The conclusion here is that the effects of computing experience on computer attitude and anxiety may depend on the kind of experience involved. It seems that when experience is provided in a structured and systematic way over a short period of time, then it may not be as beneficial to attitudes and anxiety as experience gained in a non-structured and non-systematic way over a longer period of time. This possibly happens because long-term, more general non-structured experience may relate closer to an individual's personal, occupational or recreational needs than structured and strictly specified experience does. In addition, non-structured experience can be gained in a more casual and relaxed way than experience narrowly focused in a specific type of learning material and delivered within a strict time schedule. More focused and specified experience may also be more likely to induce test (state) anxiety during the learning process, although this dimension has not been measured or studied separately within the present study.

Finally, since the higher their prior experience the more the individuals are vulnerable to decreases of attitude, when gaining additional experience from some type of computer course, it maybe that individuals well accustomed to a familiar way of learning and operating a computer system are likely to develop more rigidity to change than individuals with less prior experience. The issue of rigidity (Rehfisch, 1957) although considered and measured, was not included in the present study mainly because data on rigidity were collected only for one of the three academic years involved. It seems though that little or no literature has looked at the effects of installing new computer systems on experienced users.

Thus, the finding that computer experience, gained from some type of a computer course, relates a lot (and may also relate causally) to changes of computer attitudes, and possibly computer anxiety, again supports the idea that computer operational problems are at least part of the source of negative reactions to computers. Although, in practical terms, experience is fairly easy to increase for most individuals (exceptions may be found among computerphobics), not all types of computer experience may be seen as effective to treat the operational roots of computer attitude and anxiety by improving the former and reducing the latter.

It appears that computer anxiety, stress, and negative attitude can be relatively manageable problems that can be handled and treated in most cases by providing sufficiently large amounts of computer experience. The present findings may suggest that this computer experience should be provided over an extended time period, relate closely to users' prior experience and needs, and be conducted in a rather gradual and time-taking manner. While this approach may not

prove to be economically efficient in the short term, however, in the longer term, it may be more likely to enable users, especially the ones with advanced previous experience, to adapt easier to newly acquired computing operational skills.

On the other hand, the present findings may suggest that a brief structured computer session or a systematic series of short fast-paced and over-focused sessions, that does not consider adequately the previous experience and the needs of the 'trainees' (especially the more experienced ones) will probably not succeed in either reducing computer anxiety and stress or improving the respective computer attitude.

This might suggest, for example, that university departments that try to introduce students to computing through short, intensive sessions may be disappointed by the results; and, if this can be generalised to an occupational context, organisations and the industry that try to introduce employees to basic computing or to any computing skills through 'money and time saving' short and intensive courses may not be successful, given the results of the present research. In particular, the 'hands-on' computer approach taken by these university departments or companies is probably the right policy, because it may effectively provide the significant computer experience. However, in order to be effective, the computer sessions should be conducted over a longer time period, be more coherent with the individuals' previous experience, and probably be provided in smaller 'doses' (for example, compared to the sessions and their timing examined in the present research).

In all cases, particular care and attention should be paid to individuals who start a computing course with good knowledge of a different computer system than the one introduced by the course. Those individuals, according to the findings of the present study, are more likely to have more favourable initial attitude towards computers and have lower levels of computer anxiety before they start the computer course. However, the attitude of these individuals will be more likely to shift to the worse, and their anxiety (and stress) to increase, when they face the challenge to learn and use the new computer system that is introduced.

Furthermore, the present suggestions may be seen as complementary to the ones derived by Marcoulides (1988 and 1995) findings. In particular, Marcoulides recommended that computer students, and especially novices, should not be introduced to more 'formal' computer applications until they have become comfortable and competent in using more general, user-friendly everyday applications, such as computer communications (electronic mail) and basic word processing. Early introduction of more 'formal' and sophisticated uses, such as advanced word processing and especially programming and statistical analysis, may induce excessive stress and anxiety, decrease attitudes towards computers, and the resulting negative

reactions may inhibit subsequent learning and acquiring computer skills in a way that it may be hard and time consuming to overcome.

Educational origins: Computer knowledge

It was suggested previously that computer anxiety and negative attitude have 'personality', educational (or knowledge-based), and operational roots or origins (e.g. Raub, 1981; Howard, 1984). The operational roots, related mainly to experience, have already been discussed. In considering the knowledge-based (or educational) roots, computer knowledge and computer experience may not be regarded to be the same thing, although, within the relevant literature, they often accompany each other. In Howard's study (1986), for example, the two variables were treated as separate, and the correlation between them was found to be 0.51. However, it should be noted that computer knowledge can be distinguished from computer experience. For example, computer operators in general may have high levels of computer experience but somewhat low levels of (computer) knowledge about certain programming languages, or system software, operational systems, screen editors, electronic mail utilities, and other (technical and non-technical) aspects of computing.

According to Raub (1981), the Piagetian point of view asserts that acquiring computer knowledge is an assimilation process: (computing) students incorporate learning into an existing schema of computer acceptance. However, assimilating computer learning would not take place without the previous stage, the accommodation process: that involves the integrated intellectual and emotional acceptance of computers. If the accommodation process (computer knowledge) is not complete, computer experience may not reduce computer anxiety, fears may heighten and interfere with or even block computer learning, and self-defeating anticipation may increase. Thus, it is recommended, that students should take computer courses after the accommodation process is complete (Raub, 1981).

Since it is easier to provide computer experience than it is to increase computer knowledge, then negative reactions (stress, anxiety, and negative attitudes) towards computing that arise from lack of knowledge would be expected to be more difficult to treat and modify than negative reactions that arise from lack of experience. Thus, knowledge-originated computer anxiety, stress, and attitudes are likely to be considered as in a higher level of permanence of the stress reaction (i.e. more 'trait' and less 'state') than the operational-rooted attitudes, stress, and anxiety (mainly related to experience).

Since: a) more positive computer attitudes are related with less stress, and b) more experience is also related with less stress, then an interesting question can be: Is it attitude or experience more important in determining stress and computer performance?

The present research provided some evidence, (mainly derived from multiple regression in the third chapter), about the relative contribution of attitude and experience to the variance of stress and performance. This suggested that computer attitude (confidence and DCAS) is a fairly strong predictor in determining stress after computing sessions, and strong in predicting subjective ratings (stress and related concepts). In addition, computer anxiety (attitude) was the key predictor of stress before computer sessions. Attitude (confidence and DCAS) was also found a weak predictor of performance. However, experience only contributed slightly in predicting stress before sessions.

Since attitude seems to be more important than experience in determining outcome variables, then what is the origin of attitude? Some of the evidence within the present research, mainly derived from the ANOVAs of the second chapter, suggests that computing experience may be at the roots of computer attitude. Another possibility is that computer attitude may originate from some aspects of the personality of a computer user.

Personality origins

As previously described, the 'personality' origins of computer anxiety, computer attitudes and computer stress are related to the individual's personality characteristics. A strong clue to the nature and relationships of these characteristics are the present findings as well as similar findings within the relevant literature - all discussed in chapter 4. These findings suggest that specific personality characteristics, with emphasis on some of the locus of control dimensions, are significant correlates of computer attitudes, anxiety, stress, and performance. Personality dimensions and computer attitudes have also been found to be 'additive' predictors explaining part of the variance in computer stress and performance variables.

These findings also suggest that computer attitudes, anxiety and stress might relate differentially to personality variables, at least in the cases of some of the locus of control dimensions, neuroticism and, to a lesser extent, extraversion, and A typology. Thus, these findings may also suggest that better understanding of personality variables and their differentiation may contribute to a better understanding of the associated computer attitudes, anxiety and stress.

In considering locus of control, although findings derived from Levenson's locus of control measure went in the same direction as the ones derived from Paulhus' SOC, discrepancies of findings in the literature may to a certain extent be due to the use of different locus of control scales. Within the present research, Levenson's measure, differentiates between externals with expectancies that fate, chance, and destiny will control events, and externals with expectancies that powerful others will control events. Paulhus' measure, in contrast to

Levenson's, seems to subdivide internality rather than the external forces to provide a set of attributes for characterising individuals.

In the present research, only Paulhus' scales (in particular personal and interpersonal control) gave strong results in relation to computer attitudes. However, in relation to computer performance and difficulty, Levenson's scales (in particular chance and internal) produced greater and more significant correlations. In relation to computer stress both Paulhus' (personal and interpersonal control) and Levenson's scales (mainly chance) produced significant correlations with the stress variables.

In general, several personality variables relate to stress experienced in a computing session. Several personality variables correlate with stress variables. However, it is mainly attitude (computer confidence in particular) that accounts for most of the variance in the stress variables. Computer anxiety seemed only to relate with anticipation of a computing situation. From the personality variables, mainly neuroticism, and, to a lesser extent, locus of control were found to contribute mostly to the experienced outcome.

Furthermore, in terms of correlation, only locus of control, as conceptualised and measured by Levenson, relates with computer performance. Locus of control, and to a lesser extent instability and A typology, relates to perceived difficulty. In terms of regression, it is mainly but weakly locus of control that relates to performance, and mainly attitude (computer confidence in particular) that relates to subjective difficulty.

Locus of control (mainly personal and interpersonal as measured by Paulhus), neuroticism and A Typology (mainly Broad View of Type A) were three strong and significant correlates of computer attitude (mainly anxiety and confidence). In addition, locus of control, neuroticism and A Typology are regarded to be rather 'trait' personality characteristics or patterns and thus unlikely to change significantly in a short time (Rotter, 1966; Eysenck and Eysenck, 1963a; Cooper et al, 1988). This appears to mean that external, unstable and/or Type B students may be likely to retain their less favourable views towards computers over a long term. [This is supported by the findings that locus of control (personal and interpersonal as measured by Paulhus and 'chance' as measured by Levenson) is a fairly strong correlate of computer related stress, neuroticism is a strong correlate of stress (but not performance), and internality and 'powerful others' as measured by Levenson are correlates of computer performance].

In terms of regression, although experience explains more variation in attitudes than locus of control, and although both experience and locus of control did not explain much of the variance in the attitude variables, locus of control still made some contribution in predicting attitudes towards computers.

An implication may be derived from these (correlation and regression) findings that people who score low on internal control and A Typology and high in neuroticism should not be placed in positions involving frequent interaction with computers. However, a) since causality cannot be certainly established, b) since computer performance was weakly correlated with and predicted by locus of control, c) since performance was not found to be related with neuroticism, and d) since performance was not found to be either correlated with or predicted by A Typology, then the implication that certain individuals should not be given positions entailing frequent computing is rather weak.

Moreover, it would be very difficult to conclude from the present research that there is a single, identifiable personality type or a clear pattern of personality characteristics of an individual, that is especially vulnerable to computer anxiety, stress, and/or negative attitude, and should thus be considered to be excluded from computer operation and responsibilities entailing interaction with a computer technology interface.

3. Towards a schema of the origins of computer attitude and anxiety

Raub (1981) suggests that computer anxiety and attitudes can be regarded as similar phenomena to those of maths anxiety and attitudes respectively; thus, they must have common 'psychological' roots. For example, he suggests that similarly to the negativity towards computers of computer anxious people, maths anxious types may see mathematics, computers and several other issues related to technology as for somebody else.

However, Raub's study of computer anxiety (and attitudes) suggested that misconceptions and fears about computers may originate because students "assimilate" computer information according to a schema of "technological alienation". Thus, according to Raub, technological alienation can be considered as a significant cause of computer anxiety. Technological alienation was defined by Raub as the extent to which an individual feels "in touch" or "out of touch" with the advances of computer technology, and which could be attributed to fear of the technological unknown. Within this context, the computer anxious subjects/students were described by Raub as sharing a background of alienation or isolation from technology, and seeming as if the computer explosion of the recent past years passed by them unnoticed. Raub's conclusion was that it is from this obliviousness to technology that computer anxiety appears to originate (Raub, 1981).

In support of this, Raub's interviews with students further suggested that lack of computer experience may not be a **cause** of computer anxiety; rather it may be the **result** of feeling alienated from technology. This alienation inhibits interaction with computers, even where interaction opportunities exist. This was shown, in contrast, in Raub's students: the ones who demonstrated the least amount of computer anxiety, these ones also felt "in touch" with

technology in some way. Raub argues that opportunities must exist in childhood for motivation and interest to develop; this conclusion was drawn because Raub's non-computer anxious students appeared to have early opportunities for learning about (computer) technology, such as encouragement by parents, books and magazines describing computers' beneficial impacts on society, as well as chances to explore other relevant mechanical and electronic issues (Raub, 1981).

Thus, in Raub's view, the prime 'psychological' root of computer anxiety (including stress and negative attitude) appears to be that certain people do not see themselves as technological types; and with this predisposition they are actually defeated before they start. While there is some evidence in Howard's (1986) study to confirm the validity of this explanation, Howard's findings however suggest that the previously mentioned predisposition 'trait' does not seem to be related either to locus of control or to cognitive style. In particular, Howard concludes that "other more subtle and perhaps unknown 'psychological' variables are at play".

On the other hand, the present studies suggested that this predisposition 'trait' seems to be directly related at least with some personality characteristics, such as some of the locus of control dimensions, neuroticism, and, to a lesser extent, extraversion and A typology. In addition, this 'trait' appears to be related with computer attitudes, in particular, (obviously with computer anxiety but also) with computer confidence, which in turn seem to be (cor)related significantly with personal and interpersonal locus of control, neuroticism and A Typology.

Furthermore, in considering the correlation and multiple regression results, locus of control together with experience also contribute in determining computer attitudes in general and computer confidence in particular. In turn, computer confidence together with locus of control and neuroticism contribute in predicting computer stress, subjective difficulty, and, to a lesser extent, computer performance. In terms of regression, the only direct impact of computer anxiety is its contribution in predicting anticipatory computer stress.

Stepwise multiple regressions were conducted at this stage (not shown in Tables) to see which personality dimension carries more weight in predicting computer attitudes and to look at the contribution of these dimensions to the outcome. The intention here was to see whether attitudes can be explained by personality characteristics, and thus the effects on stress and performance due to attitudes were really just a result of personality. In other words, if (a) attitude is a result of personality and (b) stress is a result of attitudes, then is (b) due to (a)?

For each of the regressions, the dependent variable was one of the following: computer anxiety (CANX1), computer confidence (CCON1), computer liking (CLIK1), and general computer attitude (mainly liking) (DCAS1).

Levenson's internality (INT) and chance (CH), Paulhus' personal (PERS) and interpersonal (INTPERS) control, instability (or neuroticism) (INSTAB), and extraversion (EXTVER), as well as Broad view of A typology (BRVIEW) were used as independent variables. These personality variables were selected on the basis of their correlation with the dependent variables.

This analysis indicated that instability or neuroticism was the main personality dimension in predicting all attitude dimensions – however, in all cases weakly. Neuroticism explained about 9% of the variance in computer anxiety, 7% in confidence, 2% in liking and 4% in DCAS1. Broad view of A typology and personal control played some part in predicting anxiety and confidence respectively.

In summary, the present research suggests that some individuals experience computer anxiety, computer stress, and the accompanying negative computer attitude, all in anticipation of or after actual interaction with a computer either in the short term (related mostly to stress) or in the long term (related mostly to anxiety and attitude). Since stress reactions may be seen “in terms of a mismatch or unresolved tension between an existing state and a target state” (Hockey, 1984; Briner and Hockey, 1988): It maybe that the anxiety and negative attitude have their main general component in that the present technological and highly computers-using world imposes an ongoing background of anxiety and negativity in terms of liking and feeling confident about the (computer) technology; the stress induced has its main specific component in that it is specific to a particular computer (technology) interaction.

Individuals respond to this anxiety / stress and develop attitudes depending upon their experience and knowledge about computing and computers, and upon their psychological makeup, namely their personality characteristics based mainly on some of the locus of control dimensions and neuroticism. However, Howard's (1986) conclusion may be also the case that “other more subtle and perhaps unknown ‘psychological’ variables are at play”. In turn, individuals' stress and difficulty experienced specifically to a particular computer interaction, and to a lesser extent individual's performance, may be influenced by their computer attitudes (mainly computer confidence and anxiety).

It seems that in order to alleviate effectively anxiety, stress and negative attitude related to computers, a treatment should cover all levels of the problem. In particular, problems arising from operational origins may be treated relatively easily; reactions stemming from knowledge-based roots may be of intermediate difficulty to alleviate; while those coming from personality roots, and are related to an individual's personality characteristics, may be more difficult to modify.

On the other hand, the pattern of an individual's anxiety, stress and attitude may arise from each of the above origins, two of the three, or only one, depending upon the particular person. Thus, if a subject is given only computer experience, only part of the whole problem may be alleviated, since the other two sources will have remained untreated.

However, although computer anxiety and attitude related to personality characteristics may be more difficult to treat and alleviate, they are generally less common compared to the anxiety and attitude associated with computer operational concerns (such as computer experience).

REFERENCES

- Aarsteinsen, B. (1986). Fear in the executive suite. *Globe and Mail*, November 17, 1.
- Abdel-Halim, A.A. (1980). Effects of person-job compatibility on managerial relations to role ambiguity. *Organizational Behaviour and Human Performance*, 26, 193-211.
- Abler, R.M., and Sedlacek, W.E. (1987). Computer Orientation by Holland Type and Sex. *The Career Development Quarterly*: December 1987, 36, (2), 163-169.
- Abramson, L.Y., Seligman, M.E.P., and Teasdale, J.D. (1978). Learned Helplessness in Humans: Critique and Reformulation. *Journal of Abnormal Psychology*, 87, (1), 49-74.
- Agervold, M. (1987). New technology in the office: attitudes and consequences. *Work and Stress*, 11: 143-153.
- Ahl, D.H. (1976). Survey of public attitudes toward computers in society. In D.H. Ahl (eds.) *The best of creative computing*, Vol. 1, pp. 77-79. Morristown, N.J.: Creative Computing Press.
- Allport, G.W. (1937). *Personality: A psychological interpretation*. New York: Holt.
- Alspaugh, C.A. (1972). Identification of some components of computer programming aptitude. *Journal of Research in Mathematics Education*, 3, 89-98.
- Amick, B.C., and Celantano, D. (1991). Structural determinants of the psychosocial work environment: an exploratory model of the role of technology in work stress. *Ergonomics*.
- Amick, B.C., and Ostberg, O. (1987). Office automation, occupational stress, and health: a literature analysis with specific attention to expert systems. *Office: Technology and People*, 4, 191-210.
- Anderson, B., and Orcutt, J. (1977). Social interaction, dehumanization and the "computerized other". *Sociology and Social Research*, 61, 380-397.
- Anderson, C.P. (1977). Locus of control, coping behaviours and performance in a stress setting: a longitudinal study. *Journal of Applied Psychology*, 62, 446-451.
- Anderson, J. (1983). The heartbreak of cyberphobia. *Creative Computing*, 114, (117-118), 125-128.
- Anderson, R.E., Hansen, T.P., Johnson, D.C., and Klassen, D.L. (1979). *Minnesota Computer Literacy and Awareness Assessment*. Minnesota Educational Computing Consortium, St Paul, 1979.
- Anderson, R.E., and Klassen, D.L. (1981). A conceptual framework for developing computer literacy instruction. *Association for Educational Data Systems (AEDS) Journal*, 14, 128-150.
- Anderson, R.E., Klassen, D.L., Hansen, T.P., and Johnson, D.C. (1980-81). The affective and cognitive effects of microcomputer based science instruction. *Journal of Educational Technology Systems*, 9, 329-355.
- Andrisani, P.J., and Nestel, G. (1976). Internal-External Control as Contributor to and Outcome of Work Experience. *Journal of Applied Psychology*, 61, (2), 156-165.
- Ansley, J., and Erber, J.T. (1988). Computer Interaction: Effect on Attitudes and Performance in Older Adults. *Educational Gerontology*, 14, (2), 107-119.
- Appelbaum, S.H., and Primmer, B. (1990). Technology Tie-In. *An HRX for Computer Anxiety. Personnel*: September 1990, 67, (9), 8-11.
- Arndt, S., Clevenger, J., and Meiskey, L. (1985). Students' attitudes toward computers. Paper presented at Conference on Computers and Society, Rochester, NY.
- Arndt, S., Feltes, J., and Hanak, J. (1983). Secretarial attitudes towards word processors as a function of familiarity and locus of control. *Behaviour and Information Technology*, 2: 1, pp 17-22.

- Badagliacco, M. (1990). Gender and race differences in computing attitudes and experience. *Social Science Computer Review*, 8, (1), 42-64.
- Baker, J.C. (1978). A factor analysis of high school students' attitudes concerning the computer. Unpublished paper, University of Pennsylvania.
- Ballance, C.T., and Ballance, V.V. (1996). Psychology of computer use. 37. Computer related stress and amount of computer experience. *Psychological Reports*, 78, 3:1, 968-970.
- Bander, R.S., Russell, R.K., and Zamostny, K.P. (1982). A comparison of cue-controlled relaxation and study skills counseling in the treatment of mathematics anxiety. *Journal of Educational Psychology*, 74: 96-103.
- Barfield, W. (1984). Stress as a function of increased cognitive load at a VDT. In E. Grandjean, (eds), *Ergonomics and Health in Modern Offices*, Taylor and Francis, pp 181-186.
- Barkin, S. (1974). An investigation into some factors affecting information system utilization. Unpublished Ph.D. dissertation, University of Minnesota.
- Bar-Tal, D., and Bar-Zohar, Y. (1977). The relationship between perception of locus of control and achievement: review and some educational implications. *Contemporary Psychology*, 22, 181-199.
- Batlis, N.C. (1980). Job involvement and locus of control as moderators of role-perception / individual outcome relationships. *Psychological Reports*, 46, 111-119.
- Bear, G.G., Richard, H.C., and Lancaster, P. (1987). Attitudes toward computers: validation of a computer attitudes scale. *Journal of Educational Computing Research*, 3, 207-218.
- Beehr, T.A., and Newman, J.E. (1978). Job stress, employee health, and organizational effectiveness: A facet analysis, a model, and a literature review. *Personnel Psychology*, 31, 665-699.
- Bendig, A. (1963). The relationship of temperament traits of social extraversion and emotionality to vocational interests. *Journal of General Psychology*, 69, 311-318.
- Betz, N. (1978). Prevalence, distribution, and correlates of maths anxiety in college students. *Journal of Counseling Psychology*, 25: 441-48.
- Block, J. (1977). The Eysencks and psychoticism. *Journal of Abnormal Psychology*, 86: 653-54.
- Bloom, A.J., and Hautaluoma, J.E. (1990). Anxiety Management Training as a Strategy for Enhancing Computer User Performance. *Computers in Human Behavior*, 6, (4), 337-349.
- Bohlin, G., and Kjellberg, A. (1973). Self-reported arousal during sleep deprivation and its relation to performance and physiological variables. *Scandinavian Journal of Psychology*, 16, 203-208.
- Bozeman, W.C. (1978). Human factors considerations in the design of systems of computer managed instruction. *Association for Educational Data Systems (AEDS) Journal*, 11, 89-96.
- Bralove, M. (1983). Computer anxiety hits middle management. *Wall Street Journal*, March 29, 1983.
- Brand, C.R. (1984). Personality dimensions: an overview of modern trait psychology. In J. Nicholson and H. Beloff (eds), *Psychology Survey 5*. Leicester, UK: British Psychological Society.
- Brenner, (1953). An addendum to Freud's theory of anxiety. *International Journal of Psychoanalysis* 34: 18-24.
- Briner, R.B., and Hockey, G.R.J. (1988). Operator Stress and Computer - based Work. In C.L.Cooper, and R. Payne, (Eds.), *Causes, Coping and Consequences of Stress at Work*. John Wiley and Sons, Chichester.
- Briner, R.B., Hockey, G.R.J., and Rahwan, M. (). *Sheffield Work Demands and Well-Being Study Weekly Diary Booklet*.

- Briner, R.B., Hockey, G.R.J., Tattersall, A.J., and Wiethoff, M. (1989). Assessing the impact of computer workload on operator stress: The role of system controllability. *Ergonomics*, 32, (11), 1401-1418.
- Brock, D.B., and Sulsky, L.M. (1994). Attitudes towards computers: Construct validation and relations to computer use. *Journal of Organizational Behavior*, 15, 1, 17-35.
- Brod, C. (1982). Managing technostress: optimizing the use of computer technology. *Personnel Journal*, 61, 753-757.
- Brod, O. (1984). *Technostress: the human cost of the computer revolution*. Reading, MA: Addison-Wesley.
- Broedling, L.A. (1975). Relationship of Internal-External Control to Work Motivation and Performance in an Expectancy Model. *Journal of Applied Psychology*, 60, (1), 65-70.
- Brosnan, M.J. (1998). The impact of computer anxiety and self-efficacy upon performance. *Journal of Computer Assisted Learning*, 14, 223-234.
- Brosnan, M.J. (1998). *Technophobia. The psychological impact of information technology*. Routledge.
- Brosnan, M. and Davidson, M. (1994). Computerphobia: is it a particularly female phenomenon? *The Psychologist*, 7, (2), 73-78.
- Burn, B. (1977). The role of control orientation in the perception and handling of job related technological change. *Dissertation Abstracts International*, 38B, 3445-B.
- Burrows, G., King, M., and Stanley, G. (1987). *Stress: Theory and Practice*. Grune and Stratton, New York.
- Burrows, G.C., Cox, T., and Simpson, G.C. (1977). The measurement of stress in a sales training situation. *Journal of Occupational Psychology*, 50, 45-51.
- Burrows, G.C., Cox, T., Lazzarini, A.J., and Mackay, C.J. (1978). An inventory for the measurement of self-reported stress and arousal. *British Journal of Social and Clinical Psychology*, 17, 283-284.
- Burrows, G.D., King, M.G., and Stanley, G.V. (1983). Measurement of stress and arousal: Validation of stress arousal adjective checklist. *British Journal of Psychology*, 74, 473-479.
- Byrnes, E., and Johnson, J.H. (1981). Change technology and the implementation of automation in mental health care settings. *Behaviour research methods and instrumentation*, 13, pp. 573-575.
- Cancro, R., and Slotnick, D.L. (1970). Computer graphics and resistance to technology. *American Journal of Psychotherapy*, 24, 461-469.
- Caplan, R.D., and Jones, K.W. (1975). Effects of work load, role ambiguity, and type A personality on anxiety, depression, and heart rate. *Journal of Applied Psychology* 60(6).
- Cattell, R.B. (1957). *Personality and motivation structure and measurement*. New York: World Book.
- Cattell, R.B., and Scheier, I.H. (1958). The nature of anxiety: a review of thirteen multivariate analyses comprising 814 variables. *Psychological Reports* 4: 351-388.
- Cattell, R.B., and Scheier, I.H. (1961). *The meaning and measurement of neuroticism and anxiety*. Ronald, New York.
- Cattell, R.B., and Scheier, I.H. (1963). *Handbook for the IPAT anxiety scale*. 2nd ed. Champaign: Institute for Personality and Ability Testing.
- Chen, M. (1986). Gender and Computers : The beneficial effects of experience on attitudes. *Journal of Educational Computing Research*, 2, (3), 265-282.
- Chesney, M.A., Eagleston, J.R., and Rosenman, R.H. (1980). The Type A structured interview: A behavioral assessment in the rough. *Journal of Behavioral Assessment*, 2(4), pp 255-272.

- Chesney, M.A., and Rosenman, R.H. (1983). Specificity in stress models: Examples drawn from type A behavior. In C.L. Cooper (eds), *Stress Research* (pp 21-34). NY: John Wiley and Sons.
- Christiansen, D. (1982). Computer and math anxiety. *IEEE Spectrum*, 19, 23.
- Christie, M., and Venables, P. (1973). Mood changes in reaction to age, EPI scores, time and day. *British Journal of Social and Clinical Psychology*, 12, 61-72.
- Chu, P.C., and Spires, E.E. (1991). Validating the Computer Anxiety Rating Scale: Effects of cognitive style and computer courses on computer anxiety. *Computers in Human Behavior*, 7, (1-2), 7-21.
- Clement, F.J. (1981). Affective considerations in computer-based education. *Educational Technology*, 21, pp. 28-32.
- Coch, L., and French, J.R.P., Jr (1948). Overcoming resistance to change. *Human Relations*, 1, 512-532.
- Cohen, S., Kamarck, T., and Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, 24, 385-396.
- Cohen, B.A., and Waugh, G.W. (1989). Assessing computer anxiety. *Psychological Reports*, 65, (3), 735-738.
- Collins, B.E. (1974). Four (separate) components of the Rotter Internal-External Scale: Belief in a difficult world, a just world, a predictable world and a politically responsive world. *Journal of Personality and Social Psychology*, Vol. 29, No. 3, 381-391.
- Collins, F. (1983). The V-curve: a road map for avoiding people-problems in systems changes. *Journal of Systems Management*, 34, 31-35.
- Cooper, C.L., Cooper, R.D., and Eater, L.H. (1988). *Living with Stress*. Penguin Books.
- Cooper, C.L., and Payne, R. (1988). *Causes, Coping and Consequences of Stress at Work*. John Wiley and Sons.
- Cooper, C.L., Sloan, S.J., and Williams, S. (1988). *Occupational Stress Indicator*.
- Cooper, C.L., and Sutherland, V.J. (1988). Sources of work stress. In J.J. Hurrell, Jr., L.R. Murphy, S.L. Sauter, and C.L. Cooper, (eds), *Occupational stress: Issues and developments in research*. Taylor and Francis: London, New York.
- Coovert, M.D., and Goldstein, M. (1980). Locus of control as a predictor of users' attitude toward computers. *Psychological Reports*, 47, (3), 1167-1173.
- Cox, T. (1975). The nature and management of stress. *New Behav.*, 2, 493.
- Cox, T., Burrows, G.D., and Simpson, G.C. (1977). The measurement of stress in a sales training situation. *Journal of Occupational Psychology*, 50, 45-51.
- Cox, T., and Mackay, C. (1978). The measurement of self-reported mood. *Stress and Arousal Checklist*. Instructions for Mood Adjective Checklist.
- Cox, T. (1978). *Stress*. London: Macmillan Education Ltd.
- Cox, T. (1980). Repetitive work. In C.L. Cooper and R. Payne (eds), *Current Concerns in occupational stress*, John Wiley and Sons, pp 23-41.
- Cox, T., and Mackay, C. (1985). The measurement of self-reported stress and arousal. *British Journal of Psychology*, 76, 183-186.
- Cox, T., Mackay, C.J., and Page, H. (1982). Simulated repetitive work and self-reported stress. *Journal of Occupational Behaviour*, 3, 247-252.

- Crable, E.A., Brodzinski, J.D., Scherer, R.F., and Jones, P.D. (1994). The impact of cognitive appraisal, locus of control, and level of exposure on the computer anxiety of novice computer users. *Journal of Educational Computing Research*, 10, 4, 329-340.
- Cruickshank, P.J. (1984). A stress and arousal mood scale for low vocabulary subjects. *British Journal of Psychology*, 75, 89-94.
- Cummings, T.G., and Cooper, C.L. (1979). A cybernetic framework for studying occupational stress. *Human Relations*, 32, 395-418.
- Dambrot, F.H., Watkins-Malek, M.A., Silling, S.M., Marshall, R.S., and Garver, J.A. (1985). Correlates of sex differences in attitudes toward and involvement with computers. *Journal of Vocational Behavior*, 27, (1), 71-86.
- Damos, D.L., and Bloem, K.A. (1985). Type A behavior pattern, multiple-task performance, and subjective estimation of mental workload. *Bulletin of Psychonomic Society*, 23, pp 55-56.
- Davidson, A.R., and Jaccard, J.J. (1979). Variables that moderate the attitude - behavior relation: Results of a longitudinal survey. *Journal of Personality and Social Psychology*, 37: 1364-1376.
- Dearborn, M.J., and Hastings, J.E. (1987). Type A personality as a mediator of stress and strain in employed women. *Journal of Human Stress*, Summer 1987, 53-60.
- DeLongis, A., Coyne, J., Dakof, G., Folkman, S., and Lazarus, R.S. (1982). Relationship of daily hassles, uplifts, and major life events to health status. *Health Psychology*, 1, 119-136.
- Derogatis, L., Lipman, R., Rickels, K., Uhlenhuth, E., and Covi, L. (1974). The Hopkins Symptom Checklist (HSCL). In P. Pichot (Ed) *Psychological measurements in psychopharmacology*. Vol. 7, Paris: Karger, pp 79-110.
- DeSanctis, G. (1982). An examination of an expectancy theory model of decision support system use. *Proceedings of the SMIS*.
- Dickson, G., Senn, J.A., and Chervany, N. (1977). Research in management information systems: the Minnesota Experiments. *Management Science*, 23: 913-923.
- Digman, J.M. (1988). Classical theories of trait organisation and the Big Five Factors of personality. Presented at The Annual Meeting of the American Psychologists Association, Atlanta.
- Digman, J.M. (1990). Personality structure: Emergence of the five-factor model. *Annual Review of Psychology*, 41: 417-440.
- Dolan, S., and Tziner, A. (1988). Implementing computer-based automation in the office: A study of experienced stress. *Journal of Organizational Behavior*, Vol. 9, 183-187.
- Durndell, A., Macleod, H., and Siann, G. (1987). A survey of attitudes to, knowledge about, and experience of computers. *Computers and Education*, 11: 3, pp 167-175.
- Durndell, A., and Lightbody, P. (1994). Gender and computing 1986-1992: Has anything changed? In: *Breaking old boundaries: Building new forms* (eds. A. Adams and J. Owen) pp. 465-473. *Proceedings of the 5th IFIP conference on Women Work and Computerisation*, Manchester University Press, Manchester.
- Dweck, C.S. (1975). The role of expectations and attributions in the alleviation of learned helplessness. *Journal of Personality and Social Psychology*, 31, 674-685.
- Dyck, J.L., and Smither, J.A. (1994). Age differences in computer anxiety: The role of computer experience, gender and education. *Journal of Educational Computing Research*, 10, 231-240.
- Eason, K.D. (1984). Job design and VDU operation. In B.G. Pearce (eds) *Health Hazards of VDTs?* John Wiley and Sons, Chichester.
- Egg, R., and Meschke, H. (1989). Jugendliche computer-fans: aussteiger oder aufsteiger? Eine empirische vergleichsstudie. *Psychologie in Erziehung und Unterricht*, 36, 35-45.

- Ellis, A., and Abrahams, E. (1978). *Brief psychotherapy in medical and health practice*. New York: Springer Publishing.
- Eysenck, H.J. (1947). *Dimensions of personality*. Routledge and Kegan Paul, London; New York: Praeger.
- Eysenck, H.J. (1956). The questionnaire measurement of neuroticism and extraversion. *Revista di psicologia*, 50, 113-140.
- Eysenck, H.J. (1957). *The dynamics of anxiety and hysteria*. Routledge and Kegan Paul, London.
- Eysenck, H.J. (1959a). *Manual of the Maudsley Personality Inventory*. University of London Press, London.
- Eysenck, H.J. (1960a). *The structure of human personality*. Methuen, London.
- Eysenck, H.J. (eds) (1960b). *Experiments in personality*. Routledge and Kegan Paul, London.
- Eysenck, H.J. (1960c). Levels of personality, constitutional factors, and serial influences: an experimental approach. *International Journal of soc. Psychiatry*, 6, 12-24.
- Eysenck, H.J. (eds) (1963a). *Experiments with drugs*. Pergamon Press, Oxford.
- Eysenck, H.J. (eds) (1963b). *Experiments in motivation*. Pergamon Press, Oxford.
- Eysenck, H.J. (1970). *The structure of human personality*. London: Methuen, 3rd edition.
- Eysenck, S.B.G., and Eysenck, H.J. (1963a). The validity of questionnaires and rating assessments of extraversion and neuroticism and their factorial validity. *British Journal of Psychology*, 54 51-62.
- Eysenck, S.B.G., and Eysenck, H.J. (1963c). An experimental investigation of desirability response set in a personality questionnaire. *Life Sciences*, No. 5, 343-355.
- Eysenck, S.B.G., and Eysenck, H.J. (1963d). On the dual nature of extraversion. *British Journal of soc. Clin. Psychology*, 46-55.
- Eysenck, H.J., and Eysenck, S.B.G. (1964). *Manual of the Eysenck Personality Inventory*. London University Press / Hodder and Stoughton.
- Eysenck, H.J., and Eysenck, S.B.G. (1975). *Manual of the Eysenck Personality Questionnaire*. Hodder and Stoughton, London.
- Faerber, L.G., and Ratliff, R.L. (1980). People problems behind MIS failures. *Financial Executive*, 48, 18-24.
- Fagerstrom, K., and Lisper, H. (1977). Effects of listening to car radio, experience, and personality of the driver on subsidiary reaction time and heart rate in a long-term driving task. In R. Machie (eds) *Vigilance*. New York: Plenum.
- Fennema, E., and Sherman, J.A. (1976). Fennema-Sherman Mathematics Attitudes Scale. American Psychological Association, Washington D.C.
- Fennema, E., and Sherman, J.A. (1976). Fennema-Sherman mathematics attitude scales. Instruments designed to measure attitudes toward the learning of mathematics by females and males. *Journal for Research in Mathematics Education* 7: 324-326.
- Fennema, E., Wolleat, P.L., Pedro, J.D., and Becker, A.D. (1981). Increasing women's participation in mathematics: an intervention study. *Journal for Research in Mathematics Education*, 12: 3-4.
- Findley, M.J., and Cooper, H.M. (1983). Locus of control and academic achievement: A literature review. *Journal of Personality and Social Psychology*, Vol. 44, No. 2, 419-427.
- Fishbein, M., and Ajzen, I. (1973). Attitudinal and normative variables as predictors of specific behaviours. *Journal of Personality and Social Psychology*, 27, 41-57.

- Fishbein, M., and Ajzen, I. (1975). *Belief, attitude, intentions, and behaviour. An introduction to theory and research* (Boston: Addison - Wesley).
- Fishbein, M., and Ajzen, I. (1977). Attitude - behaviour relations: A theoretical analysis and review of empirical research. *Psychological Bulletin*, 84, 888-918.
- Fishbein, M., and Ajzen, I. (1980). *Understanding attitudes and predicting social behaviour*. Englewood Cliffs, NJ: Prentice-Hall.
- Fisher, R. (1995). Senior managers and executive information systems: Examining linkages among individual characteristics, attitudes, computer use, and intentions. *Psychological Reports*, 77, 3:2, 1171-1184.
- Fisher, S. (1988). Methodological factors in the investigation of stress and health at work: The development of the epidemiological problem analysis approach. In J.J. Hurrell, Jr., L.R. Murphy, S.L. Sauter, and C. Cooper (eds), *Occupational Stress. Issues and developments in research*. Taylor and Francis: London, New York.
- Francis, L.J. (1993). The dual nature of the Eysenckian neuroticism scales: a question of sex differences? *Personality and Individual Differences*, 15, 43-59.
- Francis, L.J. (1995). The measurement of attitudes toward computers among undergraduate students in Wales: the comparison of four scales in relationship to sex, age, personality and religion. In Katz, Y.J. (ed) *Computers in Education: pedagogical and psychological implications*, Bulgarian Academy of Science, Sofia.
- Francis, L., Katz, Y., and Evans, T. (1996). The relationship between personality and attitudes towards computers: An investigation among female undergraduate students in Israel. *British Journal of Educational Technology*, Vol. 27, No. 3, pp. 164-170.
- Frankenhaeuser, M., and Johansson, J. (1982). Stress at work: psychobiological and psychosocial aspects. Paper presented at the 20th International Congress of Applied Psychology, Edinburgh, 25-31 July.
- French, J.R.P., and Caplan, R.D. (1972). Organisational stress and individual strain. In A.J. Marrow (eds.) *The failure of success*. New York: AMACOM.
- Frese, M. (1977). Psychische Störungen bei Arbeitern: Zum Einfluß von gesellschaftlicher Stellung und Arbeitsplatzmerkmalen (Beiträge zur klinischen Psychologie). Salzburg: Muller.
- Frese, M. (1986). A theory of control and complexity: Implications for software design and integration of the computer system into the work place. In M. Frese, E. Ulich, and W. Dzida (eds), *Psychological issues of human computer interaction at the work place*. Amsterdam: North Holland.
- Frese, M. (1987). A concept of control: Implications for stress and performance in human - computer interaction. In G. Salvendy, S.L. Sauter, and J.J. Hurrell, Jr. (eds), *Social, Ergonomic, and Stress Aspects of Work with Computers*, Elsevier Science Publishers B.V., Amsterdam, 1987.
- Frese, M. (1987). Human-computer interaction in the office. In C.L. Cooper, and I.T. Robertson (eds), *International Review of Industrial and Organisational Psychology*, John Wiley and Sons, Chichester.
- Frese, M., and Sabini, J. (eds) (1985). *Goal directed behavior: The concept of action in psychology*. Hillsdale: Erlbaum.
- Frese, M., Albrecht, K., Altmann, A., Lang, J., Papstein, P.V., Peyerl, R., Prumper, J., Schulte-Gocking, H., Winkmuller, I., and Wendel, R. (1987). The effects of an active development of the mental model in the training process: Experimental results on a word processing system. Manuscript.

- Frese, M., and Zapf, D. (1987). Die Einfuhrung von neuen Techniken am Arbeitsplatz verandert Qualifikationsanforderungen, Handlungsspielraum und Stressoren kaum: Ergebnisse einer Langsschnittuntersuchung. *Zeitschrift fur Arbeitswissenschaft*.
- Freud, S. (1959 - originally published 1926). *Inhibitions, symptoms, and anxiety*. London: Hogarth Press.
- Friedman, M., and Booth-Kewley, S. (1987). The 'disease-prone personality'. New York: Knopf.
- Furnham, A. (1987). A content and correlational analysis of seven locus of control scales. *Current Psychological Research and Reviews*, Vol. 6, No. 3, 244-255.
- Furnham, A. (1992, 1995). *Personality at work*. Routledge.
- Galagan, P. (1983). Treating computer anxiety with training. *Training and Development Journal*, July, 57-60.
- Gardner, D.G., Diszenza, R., and Dukes, R.L. (1993). The measurement of computer attitudes: an empirical comparison of available scales. *Journal of Educational Computing Research*, 9, 487-507.
- Giannoutsos, E. (1988). *Selective Memory Effects in Neurotic Patients: An experimental investigation*. Unpublished M.A. Thesis, University of Durham.
- Glass, C.R., and Knight, L.A. (1988). Cognitive factors in computer anxiety. *Cognitive Therapy and Research*, 12, (4), 351-366.
- Glass, D.C. (1977). Stress behavior patterns and coronary disease. *American Scientist*, 65, pp 177-187.
- Glass, D.C., and Singer, J.E. (1972). *Experiments on noise and social stressors*. New York: Academic.
- Gleitman, H. (1991). *Psychology*. Third Edition. W.W.Norton and Company - New York, London.
- Goldberg, L.R. (1981). Language and individual differences: the search for universals in personality lexicons. In L. Wheeler (eds) *Review of Personality and Social Psychology*, 2:141-65. Beverly Hills, CA: Sage.
- Goldberg, L.R. (1983). The magical number five, plus or minus two: some conjectures on the dimensionality of personality descriptors. Paper presented at a Research Seminar, Gerontology Research Centre, Baltimore City Hospitals.
- Gomez, L.M., Egan, D.E., and Bowers, C. (1986). Learning to use a text editor: some learner characteristics that predict success. *Human-Computer Interaction*, 2, 1-23.
- Gore, P.M., and Rotter, J.B. (1963). A personality correlate of social action. *Journal of Personality*, 31, 58-64.
- Grandjean, E. (1987). *Ergonomics in computerized offices*. Taylor and Francis, New York, Philadelphia.
- Grandjean, E. (1987). Design of VDT workstations. In G. Salvendy (eds), *Handbook of Human Factors*. John Wiley and Sons, New York.
- Grandjean, E., Hunting, W., and Laubli, T. (1981). Postural and visual loads at VDT workplaces. 1. Constrained postures. *Ergonomics*, Vol. 24, No. 12, pp. 917-931.
- Grandjean, E., Hunting, W., and Laubli, T. (1981). Postural and visual loads at VDT workplaces. 2. Lighting conditions and visual impairments. *Ergonomics*, Vol. 24, No. 12, pp. 933-944.
- Grandjean, E., Hunting, W., and Pidermann, M. (1983). VDT Workstation design: Preferred settings and their effects. *Human Factors*, Vol. 25, No. 2, pp. 161-175.
- Grandjean, E., Hunting, W., and Nishiyama, K. (1984). Preferred VDT Workstation settings, body posture, and physical impairments. *Applied Ergonomics*, Vol. 15, No. 2, pp. 99-104.

- Greer, J.H., Davison, G.C., Crutchel, R.I. (1970). Reduction of stress in humans through nonveridical perceived control of adverse stimulation. *Journal of Personality and Social Psychology*, 16, 731-738.
- Gressard, C.P., and Loyd, B.H. (1984a). The effects of sex, age, and computer experience on computer attitudes. *Association for Educational Data Systems (AEDS) Journal*, 40, 67-77.
- Gressard, C.P., and Loyd, B.H. (1984). Reliability and factorial validity of computer attitude scales. *Educational and Psychological Measurement*, 44, 501-505.
- Gressard, C.P., and Loyd, B.H. (1985). Age and staff development experience with computers as factors affecting teacher attitudes toward computers. *School Sci. Math.*, 85, No. 3, 203-209.
- Gressard, C.P. and Loyd, B.H. (1986). The nature and correlates of computer anxiety of college students. *Journal of Human Behaviour and Learning*, 3, (2), 29-33.
- Gressard, C.P., and Loyd, B.H. (1986). Validation studies of a new computer attitude scale. *Association for Educational Data Systems (AEDS) Journal*, Summer, 18, 295-301.
- Gressard, C.P., and Loyd, B.H. (1986). Gender and amount of computer experience of teachers in staff development programs: effects on computer attitudes and perceptions of the usefulness of computers. *Association for Educational Data Systems (AEDS) Journal*, Summer, 302-311.
- Gressard, C.P., and Loyd, B.H. (1987). An investigation of the effects of math anxiety and sex on computer attitudes. *School Sci. Math.*, 87, 125-135.
- Gressard, C.P., Loyd, B.H., and Loyd, D.E. (1987). Gender and computer experience as factors in the computer attitudes of middle school students. *Journal of Early Adolescence*, 7, (1), 13-19.
- Griswold, P.A. (1982). Longitudinal patterns of student attitudes in a computer-assisted instruction curriculum. In *Computer - Assisted Instruction and Compensatory Education: the ETS/LAUSD Study, Final Report (PR-82-19)* (Edited by Ragosta M., Holland, P.W., and Jamison, D.T.). Educational Testing Service, Princeton, N.J., 1982.
- Griswold, P.A. (1983). Some determinants of computer awareness among education majors. *Association for Educational Data Systems (AEDS) Journal*, Winter, 92-103.
- Griswold, P.A. (1985). Differences between education and business majors in their attitudes about computers. *Association for Educational Data Systems Journal (AEDS) Journal*, 18: 3, pp 131-138.
- Guilford, J.P. (1975). Factors and factors of personality. *Psychological Bulletin*, 82:802-14.
- Gurin, P., Gurin, G., Lao, R., and Beattie, M. (1969). Internal-external control in the motivational dynamics of Negro youth. *Journal of Social Issues*, 25(3), 29-53.
- Hall, J., and Cooper, J. (1991). Gender, experience and attributions to the computer. *Journal of Educational Computing Research*, 7, (1), 51-60.
- Harrington, K.V., McElroy, J.C., and Morrow, P.C. (1990). Computer anxiety and computer-based training: A laboratory experiment. *Journal of Educational Computing Research*, 6, (3), 343-358.
- Harris, A.L., and Harris, J.M. (1987). Reducing mathematics anxiety with computer assisted instruction. *Mathematics Comput. Educ.*, 21, 1-9.
- Hart, S.G., Battiste, V., Chesney, M.A., Ward, M.M., and McElroy, M. (1987). Responses of Type A and Type B individuals performing a supervisory control simulation. In G. Salvendy, S.L. Sauter, and J.J. Hurrell, Jr. (eds), *Social, Ergonomic and Stress Aspects of Work with Computers*. Elsevier Science Publishers B.V., Amsterdam, 1987.

- Hart, S.G., Battiste, V., and Lester, P.T. (1984). POPCORN: A supervisory control simulation for workload and performance research. In *Proceedings of 20th Annual Conference on Man. Cntrl* (NASA CP-2341) (pp 431-454). Washington, D.C.: Natl. Aero. and Space Administration.
- Hartley, M. (1975). The relationship of locus of control and need achievement to job satisfaction. *Dissertation Abstracts International*, 36A, 6553-A.
- Healion, J.V. (1983). Compuphobia isn't terminal. UPI article in *Youngstone Vindicator*, April 3, 1983.
- Heinssen, R.K. Jr., Glass, C.R., and Knight, L.A. (1984). Assessment of computer anxiety: The dark side of the computer revolution. Paper presented at the meeting of the Association for Advancement of Behaviour Therapy, Philadelphia.
- Heinssen, R.K. Jr., Glass, C.R., and Knight, L.A. (1987). Assessing computer anxiety: Development and validation of the Computer Anxiety Rating Scale. *Computers in Human Behaviour*, 3, 49-59.
- Hellman, H. (1976). *Technophobia: getting out of the technology trap*. New York: Evans.
- Helmes, E. (1989). Evaluating the internal structure of the Eysenck Personality Questionnaire: Objective criteria. *Multivariate Behavioural Research*, 24, 353-364.
- Hinton, J.W. (1988). *The psychophysiology of stress and personal coping styles*. John Wiley and Sons Ltd.
- Hinton, J.W. (1989). Stress model development and testing by group psychometrics and one-subject psychophysiology. Hemisphere/Harper and Row, Washington, USA.
- Hinton, J.W. (1989). Stress, health, and performance in university students.
- Hockey, G.R.J. (1984). Varieties of attentional state: the effects of environment. In R. Parasuraman and D.R. Davies (eds) *Varieties of attention*, Academic Press, New York.
- Hockey, G.R.J., Briner, R.B., Tattersall, A.J., and Wiethoff, M. (1989). Assessing the impact of computer workload on operator stress: the role of system controllability. *Ergonomics*, Vol. 32, No. 11, 1401-1418.
- Hogan, R. (1983). Socioanalytic theory of personality. In M.M. Page (eds) *1982 Nebraska Symposium on Motivation: Personality - Current theory and research*, pp. 55-89. Lincoln, NE: Univ. Nebraska Press.
- Hogan, R. (1986). *Hogan Personality Inventory*. Minneapolis, MN: National Computer Systems.
- Holmes, T.H., and Masuda, M. (1974). Life change and illness susceptibility. In B.S. Dohrenwend and B.P. Dohrenwend (eds). *Stressful life events: Their nature and effects*. New York: John Wiley.
- Horak, V.M., and Horak, W.J. (1982). The influence of student locus of control and teaching method on mathematics achievement. *Journal of Exp. Educ.*, 51, 10-21.
- Horak, W.J., and Slobodzian, K. (1980). Influence of instructional structure and locus of control on achievement of preservice elementary science teachers. *Journal of Res. Sci. Teach.*, 17, 213-222.
- House, J.S. (1981). *Work stress and social support*. Addison-Wesley, Reading, MA.
- House, J.S., McMichael, A.J., Wells, J.A., Kaplan, B.H., and Landerman, L.R. (1979). Occupational stress and health among factory workers, *Journal of Health and Social Behavior*, 20, 139-160.
- Howard, G. (1984, 1986). Computer anxiety and other determinants of managers' attitudes toward the usefulness of microcomputers in management. Unpublished doctoral dissertation, Kent State University.

- Howard, G.S., and Kernan, M.C. (1990). Computer anxiety and computer attitudes: An investigation of construct and predictive validity issues. *Educational and Psychological Measurement*, 50, (3), 681-690.
- Howard, G.S., and Smith, R.D. (1986). Computer anxiety in management: Myth or reality. *Communications of the ACM*, 29, (7), 611-615.
- Howell, W. (1976). *Essentials of industrial and organizational psychology*. Homewood, IL: Dorsey.
- Hudiburg, R.A. (1989a). Psychology of computer use: Measuring technostress: Computer-related stress. *Psychological Reports*, 64, 767-772.
- Hudiburg, R.A. (1989b). Psychology of computer use: The Computer Technology Hassles Scale: revision, reliability, and correlates. *Psychological Reports*, 65, 1387-1394.
- Hudiburg, R.A. (1990). Relating computer-associated stress to computerphobia. *Psychological Reports*, 67, (1), 311-314.
- Hudiburg, R.A., and Necessary, J.R. (1996). Coping with computer stress. *Journal of Educational Computing Research*, 15, 2, 113-124.
- Igbaria, M., and Chakrabarti, A., (1990). Computer anxiety and attitudes towards microcomputer use. *Behaviour and Information Technology*, 9, (3), 229-241.
- Ingber, D. (1981). Computer addicts. *Science Digest*, July 1981, pp. 88-91; 114.
- Innes, J.M. (1981). Social psychological approaches to the study of the induction and alleviation of stress: influences upon health and illness. In G.M. Stephenson and J.M. Davies (eds), *Progress in Applied Social Psychology*, Vol. 1, (Chichester: John Wiley).
- Ivancevich, J.M., Matteson, M.T., and Preston, C. (1982). Occupational stress, Type A behaviour and physical well-being. *Academy of Management Journal*, 25, 2, 373-391.
- James, F. (1982). Got vertigo over video displays? Maybe it's a case of cyberphobia. *Wall Street Journal*, June 8, 1982, p.37.
- Jawahar, I.M., and Elango, B. (1998). Predictors of performance in software training: Attitudes toward computers versus attitudes toward working with computers. *Psychological Reports*, 83, 1, 227-233.
- Jay, T.B. (1981). What to do about 'computerphobia'. *Educational Technology*, 21, January 1981, 47-48.
- Jay, T.B. (1981). Are you a computer 'illiterate'? *The Computing Teacher*, 8(4), 58-60.
- Jay, T.B. (1985). Defining and measuring computerphobia. *Trends in Ergonomics / Human Factors*, Vol II.
- Jenkins, C.D., Zyzanski, S.J., and Rosenman, R.H. (1979). *Jenkins Activity Survey*. New York: Harcourt Brace Jovanovich, Inc.
- Joe, V.C. (1971). Review of the internal-external control construct as a personality variable. *Psychological Reports*, 28, 619-640.
- Johansson, G., and Aronsson, G. (1984). Stress reactions in computerized administrative work. *Journal of Occupational Behavior*, 5, 158-181.
- John, O.P. (1989). Towards a taxonomy of personality descriptors. In D. Buss and N. Cantor (eds), *Personality Psychology: Recent trends and emerging directions*. New York: Springer-Verlag.
- Jordan, E.W., and Stroup, D.F. (1982). The behavioural antecedents of computer fear. *Journal of Data Education*, 22, 7-8.
- Jung, C.G. (1923). *Psychological types*.

- Kahn, H., and Cooper, C.L. (1986). Computing stress. *Current Psychological Research and Reviews*, Summer, 148-162.
- Kalimo, R., et al (1981). Mental strain in machine-paced and self-paced tasks. In G. Salvendy and M.J. Smith (eds) *Machine pacing and occupational stress*, Taylor and Francis, pp 159-167.
- Kalimo, R., and Leppanen, A. (1985). Feedback from video display terminals, performance control and stress in text preparation in the printing industry. *Journal of Occupational Psychology*, 58, 27-38.
- Kanner, A., Coyne, J., Schaeffer, C., and Lazarus, R. (1981). Comparison of two modes of stress measurement: daily hassles and uplifts versus major life events. *Journal of Behavioral Medicine*, 4, 1-39.
- Karasek, R.A. (1979). Job demands, job decision latitude, and mental strain: Implications for job redesign. *Administrative Science Quarterly*, 24, 285-308.
- Karasek, R.A., Baker, D., Marxner, F., Ahlbom, A., and Theorell, T. (1981). Job design latitude, job demands, and cardiovascular disease: A prospective study of Swedish men. *American Journal of Public Health*, 71, 634-705.
- Katz, Y.J. (1993). Achievement level, affective attributes and computer oriented attitudes: factors that contribute to more efficient end use. In Knierzinger, A. and Moser, M. (eds), *Informatics and Changes in Learning*, section 7, pp13-15, 1ST Press, Linz, Austria.
- Katz, Y.J., and Francis, L.J. (1995). Personality, religiosity and computer oriented attitudes among trainee teachers in Israel. *Computers in Human Behaviour*.
- Katz, Y.J., and Offir, B. (1991). The relationship between personality and computer related attitudes of Israeli teachers. *Education and Computing*, 7, 249-252.
- Kay, R.H. (1990). Predicting student-teacher commitment to the use of computer. *Journal of Educational Computing Research*, 6, (3), 299-309.
- Kay, R.H. (1993). An exploration of theoretical and practical foundations for assessing attitudes towards computers: The Computer Attitude Measure (CAM). *Computers in Human Behaviour*, 9, 371-386.
- Keenan, A. and McBain, G.D.M. (1979). Effects of Type A behaviour, intolerance of ambiguity, and locus of control on the relationship between role stress and work-related outcomes. *Journal of Occupational Psychology*, 52, 277-285.
- Kelley, S., and Mirer, T.W. (1974). The simple act of voting. *American Political Science Review* 68 : 572-591.
- Kemery, E.R., Bedeian, A.G., Mossholder, K.W., and Touliatos, J. (1985). Outcomes of role stress: A multisample constructive replication. *Academy of Management Journal*, 28, 363-375.
- Keppel, G. (1973). *Design and analysis. A researcher's handbook*. Prentice Hall.
- Kernan, M.C., and Howard, G.S. (1990). Computer anxiety and computer attitudes: An investigation of construct and predictive validity issues. *Educational and Psychological Measurement*, 50, (3), 681-690.
- Kim, J. (1980). Relationships of personality to perceptual and behavioural responses in stimulating and non stimulating tasks. *Academy of Management Journal*, 23, 307-319.
- Kinnear, P.R., and Gray, C.D. (1997). *SPSS for Windows made simple*. Psychology Press (Taylor and Francis), Second edition
- King, M.G., Stanley, G.V., and Burrows, G.D. (1987). *Stress: Theory and Practice*. Grune and Stratton, New York.

- King, M.G., Burrows, G.D., and Stanley, G.V. (1983). Measurement of stress and arousal: Validation of the stress arousal adjective checklist. *British Journal of Psychology*, 74, 473-479.
- Kirton, M. and Mulligan, G. (1973). Correlates of managers' attitudes toward change. *Journal of Applied Psychology*, 58, 101-107.
- Kline, P. (1993). *Handbook of Psychological Testing*. Routledge.
- Knapp, R.R. (1962). *Manual of Maudsley Personality Inventory*. Educational and Industrial Testing Service, San Diego.
- Kobasa, S.C. (1979). Stressful life events, personality, and health: an inquiry into hardiness. *Journal of Personality and Social Psychology*, 37, 1-11.
- Kobasa, S.C. (1982). The hardy personality: toward a social psychology of stress and health. In G.S. Sanders and J. Suls (eds), *The Social Psychology of Health and Illness* (Hillsdale, NJ: Lawrence Erlbaum).
- Kobasa, S.C.O. (1988). Conceptualisation and measurement of personality in job stress research. In J.J. Hurrell, Jr., L.R. Murphy, S.L. Sauter, and C.L. Cooper (eds), *Occupational stress: Issues and developments in research*. Taylor and Francis: London, New York.
- Koohang A.A. (1987). A study of the attitudes of Pre-Service Teachers toward the use of computers. *Educational Communication Technology Journal*, Vol. 35, No. 3, pp 145-149.
- Koohang, A.A. (1989). Increasing users positive attitudes toward the Library computer system: A system design approach. *Library and Information Science Research*, Vol. 11, No. 4, pp. 391-397.
- Koohang, A.A. (1989). A study of attitudes towards computers: Anxiety, confidence, liking, and perception of usefulness. *Journal of Research on Computing in Education*, 22, (2), 214-288.
- Koohang, A.A., and Byrd, D.M. (1987). A study of attitudes toward the usefulness of the Library Computer System and selected variables: A further study. *Library and Information Science Research*, 9, (2), 105-111.
- Koslowsky, M., Lazar, A., and Hoffman, M. (1988). Validating an Attitude toward Computer Scale. *Educational and Psychological Measurement*, 48, (2), 517-521.
- Koslowsky, M., Hoffman, M., and Lazar, A. (1990). Predicting behavior on a computer from intentions, attitudes, and experience. *Current Psychology Research and Reviews*, 9, (1), 75-83.
- Krause, N. (1986). Stress and coping: reconceptualizing the role of locus of control beliefs. *Journal of Gerontology*, 41, 617-622.
- Krause, N. and Stryker, S. (1984). Stress and well-being: the buffering role of locus of control beliefs. *Social Science and Medicine*, 18, 783-790.
- Kraut, A. (1965). The study of role conflicts and their relationships to job satisfaction, tension, and performance. Unpublished Ph.D. dissertation, The University of Michigan.
- Kuhmann, W. (1987). Experimental investigation of psychophysiological stress reactions induced by different system response times in human-computer interaction. *Ergonomics*, 30, 933-943.
- Kumashiro, M., Kamada, T., and Miyake, S. (1989). Mental Stress with new technology at the workplace. In M.J. Smith and G. Salvendy (eds), *Work with computers: Organizational, Management, Stress, and Health Aspects*. Proceedings of the Third International Conference on Human-Computer Interaction, Boston, Massachusetts, September 18-22, 1989, Volume I.
- Lagina, S.M. (1971). A computer program to diagnose anxiety levels. *Nursing Research* 20:484.

- Lambert, M.E. (1991). Effects of computer use during coursework on computer aversion. *Computers in Human Behavior*, 7, (4), 319-331.
- Langer, E.J., and Rodin, J. (1976). The effects of choice and enhanced personal responsibility for the aged. *Journal of Personality and Social Psychology*, 34, 191-198.
- Lao, R.C. (1970). Internal-external control and competent and innovative behavior among Negro college students. *Journal of Personality and Social Psychology*, 14, 263-270.
- LaPiere, R. (1934). Attitudes versus actions. *Social Forces*, 13: 230-237.
- Lazarus, R.S. (1966). *Psychological stress and the coping process*. New York: McGraw-Hill.
- Lazarus, R.S., and Averill, J.R. (1972). Emotion and Cognition: with special reference to anxiety. In *Anxiety: Current Trends in Theory and Research*, vol. 2, ed. C.D. Spielberger. New York: Academic Press.
- Lazarus, R.S., and Folkman, S. (1984). *Stress, Appraisal, and Coping*. Springer, New York.
- Lawton, J., and Gerschner, V.T. (1982). A review of the literature on attitudes towards computers and computerized instruction. *Journal of Research and Development in Education*, 16, 50-55.
- Lee, R.S. (1970). Social attitudes and the computer revolution. *Public Opinion Quarterly*, 34: 53-59.
- Lefcourt, H.M. (1966). Internal versus external control of reinforcement: A review. *Psychological Bulletin*, Vol. 65, No. 4, 206-220.
- Lefcourt, H.M. (1972). Internal versus external control of reinforcement revisited: Recent developments. In B.A. Maher (eds), *Progress in experimental personality research*. Vol. 6. New York: Academic Press.
- Lefcourt, H.M. (1972). Recent developments in the study of locus of control. In B.A. Maher (eds) *Progress in Experimental Psychological Research*. New York: Academic Press.
- Lefcourt, H.M. (1976). *Locus of control*. Chichester: John Wiley.
- Lefcourt, H.M. (1981). Locus of control and stress life events. In B.S. Dohrenwend and B.P. Dohrenwend (eds), *Stressful life events and their contexts*. New Brunswick, NJ: Rutgers University Press.
- Lefcourt, H.M. (1983). The locus of control as a moderator variable: stress. In H.M. Lefcourt (eds) *Research with the locus of control construct*. Vol. 2, *Developments and Social Problems*. Academic Press: London, New York.
- Lefcourt, H.M., Von Baeyer, C.L., Ware, E.E., and Cox, D.J. (1979). The multidimensional - multiattributational causality scale: the development of a goal specific locus of control scale. *Canadian Journal of Behavioral Science / Rev. Can. Sci. Comput.*, 11, No. 4, 286-304.
- Leso, T., and Peck, K.L. (1992). Computer anxiety and different types of computer courses. *Journal of Educational Computing Research*, 8, (4), 469-478.
- Levenson, H. (1972). Distinctions within the concept of internal-external control: Development of a new scale. In *proceedings, 80th Annual Convention, APA*, 7, 259-260.
- Levenson, H. (1973). Reliability of the I. P. and C. scales: a multidimensional view of locus of control. *Proceedings of the American Psychological Association*, Montreal, 1973.
- Levenson, H. (1974). Activism and powerful others: Distinctions within the concept of internal-external control. *Journal of Personality Assessment*, 38, 377-383.
- Levenson, H. (1978). The abrasive personality. *The Harvard Business Review*, 56, May/June, 86-94.
- Levenson, H. (1981). Differentiating among internality, powerful others, and chance. *Research with the locus of control construct: Vol. 1. Assessment methods*. Academic Press, New York.
- Lever, S., Sherrod, K.B., and Bransford, J. (1989). The effects of Logo Instruction on elementary students' attitudes towards computers and school. *Computers in the School*, 6, 45-65.

- Levin, T., and Gordon, C. (1989). Effect of gender and computer experience on attitudes toward computers. *Journal of Educational Computing Research*, 5, (1), 69-88.
- Levine, T., and Donitsa-Schmidt, S. (1997). Commitment to learning: Effects of computer experience, confidence and attitudes. *Journal of Educational Computing Research*, 16, 1, 83-105.
- Levine, T., and Donitsa-Schmidt, S. (1998). Computer use, confidence, attitudes, and knowledge: A causal analysis. *Computers in Human Behavior*, 14, 1, 125-146.
- Levitt, E.E. (1967). *The psychology of anxiety*. Indianapolis, Ind.: The Bobbs - Merrill Company, Inc.
- Lichtman, D. (1979). Survey of educators' attitudes toward computers. *Creative Computing*, 5: 48-50.
- Linn, R.L., and Slinde, J.A. (1977). The determination of the significance of change between pre- and post-testing periods. *Review of Educational Research*, 47: 121-150.
- Livneh, H., and Livneh, C. (1989). The five-factor model of personality: Is evidence for its cross-media premature? *Personality and Individual Differences*, 10: 75-80.
- Loyd, B.H., and Gressard, C.P. (1984a). Reliability and factorial validity of computer attitude scales. *Educational and Psychological Measurement*, 44, 501-505.
- Loyd, B.H., and Gressard, C.P. (1984b). The effects of sex, age, and computer experience on computer attitudes. *Association for Educational Data Systems (AEDS) Journal*, 40, 67-77.
- Loyd, B.H., and Gressard, C.P. (1985). Age and staff development experience with computers as factors affecting teacher attitudes toward computers. *School Sci. Math.*, 85, No. 3, 203-209.
- Loyd, B.H., and Gressard, C.P. (1986a). The nature and correlates of computer anxiety of college students. *Journal of Human Behaviour and Learning*, 3, (2), 29-33.
- Loyd, B.H., and Gressard, C.P. (1986b). Validation studies of a new computer attitude scale. *Association for Educational Data Systems (AEDS) Journal*, Summer, 295-301.
- Loyd, B.H., and Gressard, C.P. (1986c). Gender and amount of computer experience of teachers in staff development programs: effects on computer attitudes and perceptions of the usefulness of computers. *Association for Educational Data Systems (AEDS) Journal*, Summer, 302-311.
- Loyd, B.H., and Gressard, C.P. (1987). An investigation of the effects of math anxiety and sex on computer attitudes. *School Sci. Math.*, 87, 125-135.
- Loyd, B.H., Loyd, D.E., and Gressard, C.P. (1987). Gender and computer experience as factors in the computer attitudes of middle school students. *Journal of Early Adolescence*, 7, (1), 13-19.
- Lucas, H.C., JR. (1981). *Implementation, the key to successful information systems*. New York: Columbia University Press.
- Lucas, H.C., JR (1981). An experimental investigation of the use of computer-based graphics in decision making. *Management Science*, 27: 760.
- Lusk, E.J., and Kersnick, M. (1979). The effects of cognitive style and report format on task performance: the MIS design consequence. *Management Science* 25: 787-798.
- Mackay, C.J. (1980). The measurement of mood and psychophysiological activity using self-report techniques. In I. Martin and P. Venables (eds), *Techniques in Psychophysiology*. Chichester: Wiley.
- Mackay, C., Cox, T., Burrows G., and Lazzerini, T. (1978). An inventory for the measurement of self-reported stress and arousal. *British Journal of Social and Clinical Psychology*, Vol. 17, pp 283-284.
- Mackay, C., and Cox, T. (1985). The measurement of self-reported stress and arousal. *British Journal of Psychology*, 76, 183-186.

- McInerney, V., McInerney, D.M., and Sinclair, K.E. (1994). Student – teachers, computer anxiety, and computer experience. *Journal of Educational Computing Research*, 11, 1, 27-50.
- Mahmood, M.A., and Medewitz, J.N. (1989). Assessing the effect of computer literacy on subjects' attitudes, values, and opinions toward Information Technology: An exploratory longitudinal investigation using the Linear Structural Relations (LISREL) model.
- Mandler (1975). *Mind and Emotion*. Wiley.
- Marcoulides, G.A. (1984, 1985). The Computer Anxiety Rating Scale: Identifying underlying constructs. *Proceedings of the Ninth Western Educational Computing Conference*, Oakland.
- Marcoulides, G.A. (1987). *Coping with computers: A model program for alleviating computer anxiety*. Curriculum Research and Development Group, University of Hawaii.
- Marcoulides, G.A. (1988). The relationship between computer anxiety and computer achievement. *Journal of Educational Computing Research*, Vol. 4, (2), pp 151-158.
- Marcoulides, G.A. (1989). Measuring computer anxiety: The Computer Anxiety Scale. *Educational and Psychological Measurement*, 49, (3), 733-739.
- Marcoulides, G.A., Rosen, L., and Sears, D. (1985). *The Computer Anxiety Scale*. California State University, Dominguez Hills.
- Marcoulides, G.A., and Wang, X.B. (1990). A cross-cultural comparison of computer anxiety in college students. *Journal of Educational Computing Research*, 6, (3), 251-263.
- Marcoulides, G.A., Mayes, B.T., and Wiseman, R.L. (1995). Measuring computer anxiety in the work environment. *Educational and Psychological Measurement*, Vol. 55, No. 5, pp 804-810.
- Margarita, P. (1985). Getting comfortable with your computer. *Management World*, (May), 18-19.
- Marshall, J.C., and Bannon, S.H. (1986). Computer attitudes and computer knowledge of students and educators. *Association for Educational Data Systems (AEDS) Journal*, Summer, 270-286.
- Mason, R.I., and Mitroff, I. (1973). A program for research on management information systems. *Management Science*, 19: 475-487.
- Matthews, K.A. (1982). Psychological perspectives on the Type A behaviour pattern. *Psychological Bulletin*, 91, 293-323.
- Maurer, M. (1983). Development and validation of a measure of computer anxiety. Unpublished Master's Thesis. Ames: Iowa State University.
- Maurer, M.M. (1994). Computer anxiety correlates and what they tell us. A literature review. *Computers in Human Behavior*, 10, 3, 369-376.
- Maurer, M., and Simonson, M. (1984). Development and validation of a measure of computer anxiety. *The Convention of the Association for Educational Communications and Technology*, Dallas, 318-330.
- May, R. (1977). *The meaning of anxiety*. New York: W.W.Norton.
- McCrae, R.R., and Costa, P.T. Jr. (1985a). Comparison of EPI and psychoticism scales with measures of the five-factor theory of personality. *Personality and Individual Differences*, 6:587-97.
- McCrae, R.R., and Costa, P.T. Jr. (1985b). Updating Norman's "adequate taxonomy": intelligence and personality dimensions in natural languages and questionnaires. *Journal of Personality and Social Psychology*, 49:710-721.
- McCrae, R.R., and Costa, P.T. Jr. (1989). Reinterpreting the Myers-Briggs Type Indicator from the perspective of the five-factor model of personality. *Journal of Personality*, 57:17-40.

- McKinley, J.C., et al (1951). The Minnesota Multiphasic Personality Inventory. New York: Psychological Corporation. Revised edition.
- McLellan, D. (eds) (1977). Karl Marx: Selected writings. Oxford: Oxford University Press.
- McMichael, A.J. (1978). Personality, behavioural, and situational modifiers of work stressors. In C.L. Cooper and R. Payne, (eds), Stress at work (Chichester: John Wiley).
- Meddis, R. (1969). The analysis of mood ratings. Unpublished PhD thesis, University of London.
- Meddis, R. (1972). Bipolar factors in mood adjective checklists. *British Journal of Social and Clinical Psychology*, 11, 187-184.
- Meichenbaum, D.H. (1977). Cognitive-behavior modification: an integrative approach. New York: Plenum Press.
- Meier, S.T. (1986). Computer Aversion. *Computers in Human Behaviour*, 1, 171-179.
- Miller, R. (1983). Human ease of use criteria and their trade-offs. IBM Poughkeepsie Technical Report, TTR00.2185.
- Minch, R.P., and Ray, N.M. (1986). Alienation and computer user attitudes. In *Proceedings of the Seventh International Conference on Information Systems* (pp. 168-180). Baltimore: International Conference on Information Systems.
- Minch, R.P., and Ray, N.M. (1986). Alienation as an explanation of computer user attitudes. In *Proceedings of the 1986 Annual Meeting of the Decision Sciences Institute* (pp. 586-588). Atlanta: Decision Sciences Institute.
- Mirels, H.L. (1970). Dimensions of internal versus external control. *Journal of Consulting and Clinical Psychology*, 34, 226-228.
- Moldafsky, N.I. and Kwon, I.W. (1994). Attributes affecting computer aided decision making. A literature survey. *Computers in Human Behaviour*, 10, 3, 299-323.
- Morrison, P.R. (1983). A survey of attitudes towards computers. *Communications of the ACM*, 26, 1051-1057.
- Morrow, P.C., McElroy, J.C., and Prell, E.R. (1986). Attitudinal and behavioural correlates of computer anxiety. *Psychological Reports*, 59, (3), 1199-1204.
- Myers, I.B., and McCauley, M.H. (1985). Manual: A guide to the development and use of the Myers-Briggs Type Indicator. Palo Alto, CA: Consulting Psychologists Press.
- National (US) Research Council (1983), Video Displays, Work, and Vision (National Academy Press, Washington, DC).
- Naylor, F.D., and Guardy, E. (1973). The relationship of adjustment, anxiety, and intelligence to mathematics performance. *The Journal of Educational Research*, 66:413-417.
- Nickell, G., and Pinto J. (1986). The computer attitude scale. *Computers in Human Behavior*, 2, 301-306.
- Nishiyama, K., Nataseko, M., and Uehata, T. (1984). Health aspects of VDT operators in the newspaper industry. In E. Grandjean (eds), *Ergonomics and Health in Modern Offices*. London: Taylor and Francis, pp. 113-118.
- Norman, D.A. (1986). Cognitive engineering. In D.A. Norman and S.W. Draper (eds), *User centered system design*. Hillsdale: Erlbaum.
- Norman, W.T. (1963). Toward an adequate taxonomy of personality attributes: replicated factor structure in peer nomination personality ratings. *Journal of Abnormal Social Psychology*, 66:574-83.
- Norman, W.T. (1967). 2,800 personality trait descriptors: Normative operating characteristics for a university population. Res. Rept. 08310-1-T. Univ. Mich., Ann Arbor, MI.

- Nowlis, V. (1965). Research with the mood adjective checklist. In S.S. Tomkins and C.E. Izard (eds), *Affect, Cognition, and Personality*. New York: Springer.
- Office of Technology Assessment, Congress of the United States (1985), *Automation of America's Offices*, OTA-CIT-287 (US Government Printing Office, Washington, DC).
- Oetting, E.R. (1983). *Manual of Oetting's Computer Attitude Scale (COMPAS)*. Fort Collins, CO: Rocky Mountain Behavioral Science Institute.
- Organ, D.W. (1975). Extroversion, locus of control, and individual differences in conditionability in organizations. *Journal of Applied Psychology*, Vol. 60, No. 3, 401-404.
- Orpen, C. (1982). Type A personality as a moderator of the effects of role conflict, role ambiguity and role overload on individual strain. *Journal of Human Stress*, 8, (2), 8-14.
- Ostrom, T.M. (1969). The relationship between the affective, behavioral, and cognitive components of attitudes. *Journal of Experimental Social Psychology*, 9, 12-30.
- Pakula, A. (1984). *Computers and Society: A study of beliefs about the implications of the new technology*. Unpublished manuscript.
- Palenzuela, D.L. (1987). Sphere-specific measures of perceived control: Perceived contingency, perceived competence, or what? A critical evaluation of Paulhus and Christie's approach. *Journal of Research in Personality*, 21, 264-286.
- Parasuraman, S., and Igarria, M. (1990). An examination of gender differences in the determinants of computer anxiety and attitudes toward microcomputers among managers. *International Journal of Man-Machine Studies*, 32, (3), 327-340.
- Parkes, K.P. (1984). Locus of control, cognitive appraisal, and coping in stressful episodes. *Journal of Personality and Social Psychology*, 3, 655-668.
- Paul, L. (1982). Research on cyberphiliacs, cyberphobiacs reveals 30% of workers fear computers. *Computerworld*, April 5, 1982.
- Paulhus, D.L. (1983). Sphere-specific measures of perceived control. *Journal of Personality and Social Psychology*, Vol. 44, No. 6, 1253-1265.
- Paulhus, D.L. (1984, 1985, 1986, 1987). Spheres of control norms. Unpublished raw data.
- Paulhus, D.L., Molin, J., and Schuchts, R. (1979). Control profiles of football players, tennis players, and nonathletes. *Journal of Social Psychology*, 108, 199-205.
- Paulhus, D.L., and Christie, R. (1981). Spheres of control: An interactionist approach to assessment of perceived control. In H.M. Lefcourt (eds), *Research with the Locus of Control Construct (Vol 1): Assessment methods* (pp. 161-188). NY: Academic Press.
- Paulhus, D.L., and Van Selst, M. (1989). *The Spheres of Control Scale: Ten years of research*.
- Payne, R. (1988). Individual differences in the study of occupational stress. In C.L. Cooper and R. Payne, (eds), *Causes, Coping and Consequences of Stress at Work*. John Wiley and Sons, Chichester.
- Peace, M.S., and Easterby, R.S. (1973). The evaluation of user interaction with computer-based information systems. *Human Factors*, 15, 163-177.
- Peck, D. and Whitlow, D. (1975). *Approaches to personality theory*. London: Methuen.
- Phares, E. (1976). *Locus of control in personality*. General Learning Press, Morristown, N.J.
- Phares, E. (1984). *Research with the locus of control construct*. Vol 1 and 2. Academic Press, New York.
- Piele, D.T. (1979). Micros "GOTO" School. *Creative Computing*, 5(9), 132-134.

- Pilotte, W.J., and Gable, R.K. (1990). The impact of positive and negative item stems on the validity of a computer anxiety scale. *Education and Psychological Measurement*, 50, (3), 603-610.
- Powers, W.G., Cummings, H.W., and Talbott, R. (1973, April). The effects of prior computer exposure on man-machine computer anxiety. Paper presented at the meeting of the International Communication Association, Montreal.
- Ransford, H.K. (1968). Isolation, powerlessness, and violence: A study of attitudes and participation in the Watts riot. *American Journal of Sociology*, 73, 581-591.
- Raub, A.C. (1981). Correlates of computer anxiety in college students. Unpublished Ph.D. dissertation, University of Pennsylvania.
- Ray, N.M., and Minch, R.P. (1986). Alienation and computer user attitudes. In *Proceedings of the Seventh International Conference on Information Systems* (pp. 168-180). Baltimore: International Conference on Information Systems.
- Ray, N.M., and Minch, R.P. (1986). Alienation as an explanation of computer user attitudes. In *Proceedings of the 1986 Annual Meeting of the Decision Sciences Institute* (pp. 586-588). Atlanta: Decision Sciences Institute.
- Ray, N.M., and Minch, R.P., (1990). Computer anxiety and alienation: Toward a definitive and parsimonious measure. *Human Factors*, 32, (4), 477-491.
- Reber, A.S. (1985). *The Penguin Dictionary of Psychology*. Penguin Books - Hazell Watson and Viney Ltd.
- Reece, M.J., and Gable, R.K. (1982). The development and validation of a measure of general attitudes toward computers. *Educational and Psychological Measurement*, 42, (3), 913-916.
- Reed, W.M., and Palumbo, D.B. (1992). The effect of BASIC instruction on problem solving skills over an extended period of time. *Journal of Educational Computing Research*, 8, (3), 311-325.
- Rich, E. (1983). Users are individuals: individualizing user models. *International Journal of Man-Machine Studies*, 18, 199-214.
- Richardson, F.C., and Suinn, R.M. (1972). The Mathematics Anxiety Rating Scale: Psychometric data. *Journal of Counseling Psychology*, 19, 551-554.
- Rim, Y. (1977). Significance of work and personality. *Journal of Occupational Psychology*, 50, 135-138.
- Ringle, M. (1981). Computer literacy: New directions and new aspects. *Computers and People*. November - December 1981, pp. 12-15.
- Robertson, I.T. (1985). Human information - processing strategies and style. *Behaviour and Information Technology*, 4, 19-29.
- Robinson, J.P., and Shaver, P.R. (1969). *Measures of social psychological attitudes*. Ann Arbor, MI: Institute for Social Research.
- Rohner, D.J. (1981). Development and validation of an index of computer anxiety among prospective teachers. Unpublished Master's Thesis. Ames: Iowa State University.
- Rosen, L., and Maguire, P (1990). Myths and Realities of Computerphobia: A Meta-Analysis. *Anxiety Research*, 3, 1, 175-191.
- Rosen, L., and Sears, D. (1984). *The Computer Anxiety Scale*. Unpublished.
- Rosen, L.D., Sears, D.C, and Weil, M.M. (1987). Computerphobia. *Behaviour Research Methods, Instruments, and Computers*, 19, (2), 167-179.
- Rosen, L.D., Sears, D.C., and Weil, M.M. (1987). The Computerphobia Reduction Program: Year 1. Program development and preliminary results. *Behaviour Research Methods, Instruments, and Computers*, 19, (2), 180-184.

- Rosen, L.D., and Weil, M.M. (1995). Computer availability, computer experience, and technophobia among public school teachers. *Computers in Human Behavior*, 11, 1, 9-31.
- Rosenberg, M.J. (1956). A structural theory of attitude dynamics. *Public Opinion Quarterly*, 24, 319-341.
- Rosenberg, M.J., and Hovland, C.I. (1960). Cognitive, affective, and behavioral components of attitudes. In M.J. Rosenberg et al. (Eds.), *Attitude organization and change*. New Haven, CT: Yale University Press.
- Rosenbluth, G.S., and Reed, W.M. (1992). The effects of writing-process-based instruction and word processing on remedial and accelerated 11th graders. *Special Issue; Computer use in the improvement of writing. Computers in Human Behavior*, 8, (1), 71-95.
- Rosenman, R.H., Friedman, M., and Straus, R. (1964). A predictive study of CHD. *Journal of the American Medical Association*, 189, 15-22.
- Rubin, C. (1983). Some people should be afraid of computers. *Personal Computing*, 55-57, 163.
- Rotter, J.B. (1966). Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs: General and Applied*, Vol. 80, No. 1, pp. 1-28 (Whole No. 609).
- Rotter, J. (1971). External and internal control. *Psychology Today*, 5(1), 37-42.
- Rounds, J.B. Jr., and Hendel, D. (1980). Measurement and dimensionality of mathematics anxiety. *Journal of Counseling Psychology*, 27:138-149.
- Russell, J.A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, 39, 1161-1178.
- Sainfort, P.C., and Lim, S.Y. (1989). A longitudinal study of stress among VDT workers: Preliminary results. In M.J. Smith and G. Salvendy (eds), *Work with computers: Organizational, Management, Stress and Health Aspects*, Elsevier Science Publishers B.V., Amsterdam, 1989.
- Sandberg - Diment, E. (1982). Personal computers: the children seem to know no fear. *The New York Times*, August 17, 1982.
- Schleifer, L.M., and Okogbaa, O.G. (1990). System response time and method of pay: cardiovascular stress effects in computer-based tasks. *Ergonomics*, Vol. 33, No. 12, pp 1495-1509.
- Schraml, M.L. (1981). The psychological impact of automation on library and office workers. *Special Libraries*, 72, 149-156.
- Schuler, R.S. (1980). Definition and conceptualization of stress in organizations. *Organizational Behavior and Human Performance*, 25, 184-215.
- Schwarzer, R., Ploeg, H.M. van der, and Spielberger, C.D. (1982). Test anxiety: An overview of theory and research. In R. Schwarzer, H.M. van der Ploeg, and C.D. Spielberger (eds), *Advances in test anxiety research*. Vol. 2. Hillsdale, NJ: Erlbaum. Pp.3-9.
- Sebrechts, M.M., Deck, J.G., Wagner, R.K., and Black, J.B. (1984). How human abilities affect component skills in word processing. *Behaviour Research Methods, Instruments, and Computers*, 16, 234-237.
- Seeman, M. (1959). On the meaning of alienation. *American Sociological Review*, 24, 782-791.
- Seeman, M. (1971). Alienation: A map. *Psychology Today*, 5, August, pp. 83-84, 94-95.
- Seligman, M.E.P. (1975). *Helplessness: On depression, development, and death*. San Francisco: Freeman.
- Selye, H. (1956). *The stress of life*. McGraw-Hill, New York.
- Semmer, N. (1984). *Stressbezogene Tätigkeitsanalyse: Psychologische Untersuchungen zur Analyse von Stress am Arbeitsplatz*. Weinheim: Beltz.

- Semmer, N., and Frese, M. (1987). Control at work as moderator of the effect of stress at work on psychosomatic complaints. A longitudinal study with objective measurement. Munchen: Manuscript.
- Shaffer, R.A. (1982). Professional and business interest in personal computer swells. *Wall Street Journal*, October 8, 1982.
- Shapiro, S.F. (1980). Quelling the fear of computers. *Journal of Technical Writing and Communication*.
- Sharma, S. (1987). Learners' cognitive styles and psychological types as intervening variables influencing performance in computer science courses. *Journal of Educational Technology Systems*, 15, 391-401.
- Shore, J. (1985). The sachertorte algorithm and other antidotes to computer anxiety. New York: Viking Press.
- Shouksmith, G. (1970). Intelligence, creativity, and cognitive style. New York: John Wiley and Sons.
- Sigurdsson, J.F. (1991). Computer experience, attitudes toward computers and personality characteristics in psychology undergraduates. *Personality and Individual Differences*, 12, 617-624.
- Simonson, M.R., Maurer, M., Montag-Torardi, M., and Whitaker, M. (1987). Development of a standardized test of computer literacy and a Computer Anxiety Index. *Journal of Educational Computing Research*, 3, (2), 231-247.
- Sims, H., and Szilagyi, A. (1975). Locus of control and expectancies across multiple occupational levels. *Journal of Applied Psychology*, 60, 638-640.
- Singh, M. (1978). The relationship of job satisfaction with locus of control, organizational setting, and education. *Dissertation Abstracts International*, 39A, 648-A.
- Smith, M.J. (1987). Mental and physical strain at VDT workstations. *Behaviour and Information Technology*, 6, 243-255.
- Smith, M.J., et al (1981a). An investigation of health complaints and job stress in video display operations. *Human Factors*, 23, 387-400.
- Smith, M.J., et al (1981b). Stress and health effects in paced and unpaced work. In G. Salvendy and M.J. Smith (eds), *Machine pacing and occupational stress*, Taylor and Francis, pp 261-267.
- Spector, P.E. (1982). Behaviour in organisations as a function of employees' locus of control. *Psychological Bulletin*, 91, 482-497.
- Spielberger, C.D. (ed. 1966). *Anxiety and behaviour*. New York: Academic Press.
- Spielberger, C.D., Gorsuch, R.L., and Lushene, R.E. (1970). *State-trait anxiety inventory manual*. Pato Alto, Calif.: Consulting Psychologists Press.
- Spielberger, C.D. (1972). The nature and measurement of anxiety. In C.D. Spielberger (eds), *Anxiety: Current trends in theory and research* (Vol. 1). New York: Academic Press.
- Stellman, J.M., Klitzman, S., Gordon, G.C., and Snow, B.R. (1987). Work environment and the well-being of clerical VDT workers. *Journal of Occupational Behaviour*, 8, 95-114.
- Sternberg, R.J., and Detterman, D.K. (1986). *What is Intelligence?* Ablex, Norwood, NJ.
- Stevens, D.J. (1982). Educators' perceptions of computers in education: 1979 and 1981. *Association for Educational Data Systems (AEDS) Journal*, Fall, 1-5.
- Stevens, D.J. (1983). Cognitive processes and success of students in instructional computer courses. *Association for Educational Data Systems (AEDS) Journal*, Summer 1983.
- Stevenson, R.J. (1986). *The Durham Computer Attitude Scale*.
- Stratton, P., and Hayes, N. (1988). *A Student's Dictionary of Psychology*. Edward Arnold.

- Strickland, B.R. (1965). The prediction of social action from a dimension of internal - external control. *Journal of Social Psychology*, 66, 353-358.
- Syrotnick, J.M. and D'Arcy, C. (1982). Occupational stress, locus of control and health among men in a prairie province. *Canadian Journal of Behavioural Science*, 14(2), 122-133.
- Taylor, J.A. (1953). A personality scale of manifest anxiety. *Journal of Abnormal and Social Psychology*, 48:285-290.
- Tellegen, A. (1985). Structures of mood and personality and their relevance to assessing anxiety with an emphasis on self-report. In A.Tuma and J. Maser (eds), *Anxiety and the Anxiety Disorders*, pp. 681-706. Hillsdale, NJ: Erlbaum.
- Temple, L.L., and Gavillet, M. (1990). The development of computer confidence in seniors: An assessment of changes in computer anxiety and computer literacy. *Activities, Adaption and Ageing*, 14, (3), 63-76.
- Thayer, R.E. (1967). Measurement of activation through self-report. *Psychological Reports*, 20, 663-678.
- Thayer, R.E. (1970). Activation states as assessed by verbal report and four psychophysiological variables. *Psychophysiology*, 7, 86-94.
- Thayer, R.E. (1978). Factor analytic and reliability studies on the activation-deactivation adjective checklist. *Psychological Reports*, 42, 747-756.
- Themes, Sr.E. (1982). Three methods of reducing math anxiety in women. Unpublished Ph.D. dissertation, Kent State University.
- Throop, W., and MacDonald, A.P. (1971). Internal - external locus of control: A bibliography. *Psychological Reports*, (28, Monograph Suppl. 1), 175-190.
- Titus, R.O. (1983). Overcoming computer phobia. *Interface Age*, April 1983.
- Tobin, K.G., and Capie, W. (1982). Relationships between formal reasoning ability, locus of control, academic engagement and integrated process skill achievement. *Journal of Research on Science Teaching*, 19, 113-121.
- Todman, J., and Monaghan, E. (1994). Qualitative differences in computer experience, computer anxiety, and student use of computers. A path model. *Computers in Human Behavior*, 10, 4, 529-539.
- Tosi, H.L., Rizzo, J.R., and Carroll, S.J. (1986). *Managing Organizational Behavior*. Pitman, Marshfield.
- Totman, R.G. (1979). *Social causes of illness*. Souvenir Press, London.
- Turnbull, A. (1976). Selling and the salesman: Prediction of success and personality change. *Psychological Reports*, 38, 1175-1180.
- Turner, J.A. (1980). Computers in bank clerical functions: implications for productivity and the method of coal getting. *Human Relations*, 4, 3-38.
- Turner, J.A., and Karasek, R.A. (1984). Software ergonomics: effects of computer application design parameters on operator task performance and health. *Ergonomics*, 27, 663-90.
- Van Dijkhuizen, N., and Reiche, H. (1980). Psychosocial stress in industry: a heart-ache for middle management? *Psychotherapy and Psychosomatics*, 34, 124-134.
- Veer, G.C. van der, Tauber, M.J., Waren, Y., and Muylwijk, B. van (1985). On the interaction between system and user characteristics. *Behaviour and Information Technology*, 4, 289-308.
- Wagman, M. (1983). A factor analytic study of the psychological implications of the computer for the individual and society. *Behavior Research Methods and Instrumentation*, 15, (4), 413-419.

- Wallace, M., and Buckle, P.W. (1987). Ergonomic aspects of neck and upper limb disorders. *International Reviews of Ergonomics*, 1, 173-200.
- Waller, N.G., and Ben-Porath, Y. (1987). Is it time for clinical psychology to embrace the five-factor model of personality? *American Psychologist*, 42: 887-89.
- Wankowski, J. (1973). Temperament, Motivation and Academic Achievement. University of Birmingham: Unpublished report.
- Watt, D.H. (1980). Computer literacy: what should schools be doing about it? *Classroom Comput. News*, 1, 1-26.
- Watts, C., Cox, T., and Robson, J. (1983). Morningness - eveningness and diurnal variations in self-reported mood. *Journal of Psychology*, 113, 251-256.
- Weeter, R., and Halcomb, C. (1986). Factors influencing negative perception of computers. Paper presented at the Southwestern Psychological Association, Fort Worth, TX.
- Weigel, R.H., Vernon, D.T.A., and Tognacci, L.N. (1974). Specificity of the attitude as a determinant of attitude - behavior congruence. *Journal of Personality and Social Psychology*, 30: 724-728.
- Weil, M. and Rosen, L. (1995). The psychological impact of technology from a global perspective: A study of technological sophistication and technophobia in university students from 23 countries. *Computers in Human Behaviour*, 11, 1, 95-133.
- Weinberg, S.B. (1980). Identification of computer anxiety. Connecticut Research Foundation report 5170-000-22-0218-35-270.
- Weinberg, S.B. (1982, August). Coping with cyberphobia. *Mademoiselle*, p. 12.
- Weinberg, S.B. (1983). Interviewed by Geoffrey S. Howard, Saint Joseph's University, Philadelphia, Pa. April 8, 1983.
- Weinberg, S.B., and English, J.T. (1983). Correlates of cyberphobia. Unpublished paper, Saint Joseph's University, Philadelphia, PA.
- Weinberg, S.B., English, J.T., and Mond, C.J. (1981). A strategem for reduction of cyberphobia. *Proceedings of the AAAS Convention*.
- Weinberg, S.B. (1985). *Computerphobia*. New York: Banbury Books.
- Weiss, J. (1977). Psychosomatic disorders. In J.D. Maser and M.E.P. Seligman (eds), *Psychopathology: Experimental models* (pp 252-269). San Francisco: Freeman.
- Wesley, B.E., Krockover, G.H., and Hicks, C.R. (1985). Locus of control and acquisition of computer literacy. *Journal of Computer Based Instruction*, 12, Winter, 12-16.
- Wicker, A.W. (1969). Attitudes versus action: The relationship of verbal and overt behavioral responses to attitude objects. *Journal of Social Issues*, 25: 41-78.
- Wicklund, R.A. (1984). *Freedom and reactance*. Hillsdale: Erlbaum.
- Widiger, T.A., Knudson, R.M., and Rorer, L.G. (1980). Convergent and discriminant validity of measures of cognitive style and abilities. *Journal of Personality and Social Psychology*, 39, 116-129.
- Williges, R.C., Williges, B.H., and Elkerton, J. (1987). Software interface design. In G. Salvendy (eds), *Handbook of Human Factors*, John Wiley and Sons, New York.
- Winfred, A. Jr., and Olson, E. (1991). Computer attitudes, computer experience, and their correlates: An investigation of path linkages. *Teaching of Psychology*, 18, (1), 51-54.
- Witkin, H.A., Oltman, P.K., Raskin, E., and Karp, S.A. (1971). *A manual for the embedded figures test*. Palo Alto, California: Consulting Psychologists Press.

- Woodrow, J.E.J. (1987). Educators' attitudes and predispositions towards computers. *Journal of Comput. Math. Sci. Teach.*, 6, 27-37.
- Woodrow, J.E.J. (1990). Locus of Control and student-teacher computer attitudes. *Computers and Education*, 14, (5), 421-432.
- Woodrow, J.E.J. (1991). Locus of Control and computer attitudes as determinants of the computer literacy of student-teachers. *Computers and Education*, 16, (3), 237-245.
- Woodrow, J.E.J. (1991). A comparison of four computer attitude scales. *Journal of Educational Computing Research*, 7, 165-187.
- Woodrow, J.E.J. (1994). The development of computer related attitudes of secondary students. *Journal of Educational Computing Research*, 11, 4, 307-338.
- World Health Organization (1987), *Visual Display Terminals and Workers' Health*, WHO Offset Publication No. 99 (Geneva).
- Zhang, Y.X., and Espinoza, S. (1997). Affiliations of computer self-efficacy and attitudes with need for learning computer skills. *Journal of Educational Computing Research*, 17, 4, 371-383.
- Zmud, R.W. (1980). The role of individual differences in MIS implementation success. *Proceedings of the 12th Annual Meeting of the American Institute for Decision Sciences* 1:215.
- Zuckerman, M. (1960). The development of an affect adjective check list for the measurement of anxiety. *Journal of Counseling Psychology*, 24:457-462.
- Zuckerman, M., Kuhlman, D.M., and Camac, C. (1988). What lies beyond E and N ? Factor analyses of scales believed to measure basic dimensions of personality. *Journal of Personality and Social Psychology*, 54: 96-107.

TECHNICAL APPENDIX ONE

Psychometric characteristics of the Computer Attitude Scale

The CAS was initially developed by Loyd and Gressard (1984) for use with high school students. Since then the scale has been used to measure the attitudes of teachers, junior secondary students (in grades eight through twelve) as well as college students. Normative data, for this instrument, derived from Loyd and Gressard's studies, are summarised in Table 1.

Table 1: Normative data for the attitude scales

	M	SD	α	Pop.	N
Computer Anxiety	45.7*	7.79	0.86	Gr 8-12	188
Computer Confidence	46.1	8.91	0.91	Gr 8-12	188
Computer Liking	43.3	9.00	0.91	Gr 8-12	188
Computer Anxiety	32.7**	5.95	0.89	Teachers	192
Computer Confidence	31.8	5.56	0.89	Teachers	192
Computer Liking	33.5	5.66	0.89	Teachers	192

*Max = 60; **max = 40

The reliability and validity of the subscales were determined by internal consistency (alpha coefficient) and factor analysis. In general alpha coefficients calculated for the three subscales ranged from 0.87 to 0.91 (Gressard and Loyd, 1985). In particular the reliability and factorial validity of the CAS, and its three subscales are examined in Loyd's and Gressard's 1984 study. This study involved 155 eighth-through twelfth-grade students. The coefficient alpha reliabilities were calculated to be 0.86, 0.91, 0.91, and 0.95 for Computer Anxiety, Computer Confidence, Computer Liking and Total Score, respectively. Very similar reliabilities were obtained from their subsequent 1986 and 1987 studies. Although the overall reliability of the scale is high, Loyd and Gressard (1984) reported that a principal components factor analysis (using orthogonal rotation) yielded three distinct factors. So, as predicted, factor analysis showed substantial loadings of items that measured each of the three factors.

Also, the reliability co-efficients of the three subscales and the findings of a factor analysis obtained in a validation study of The Computer Attitude Scale (Loyd and Gressard, 1986) suggest that the three subscales are sufficiently defined to be used as separate scores. The research of Loyd and Gressard (1986, 1985, and 1984) has demonstrated that computer experience predictably influences how both students and teachers score on the test subscales - a fact which Bear et al (1987) cite as preliminary evidence for judging the validity of computer attitude scales. Also experience with computers was found to be significantly and negatively

correlated with computer anxiety. No clear age trends were established, and sex was not significantly related to computer anxiety.

Means, standard deviations, and the Cronbach α coefficients of reliability have been obtained for the three subscales (Woodrow, 1990) and are given in Table 2.

Table 2: Means, standard deviations, and reliability coefficients for CAS

	M	SD	α	N
Computer Anxiety	36.1*	6.03	0.81	105
Computer Confidence	35.2	6.48	0.87	105
Computer Liking	36.5	6.34	0.86	105

*Max = 50

Intercorrelations among the three attitude dimensions of Computer Anxiety, Computer Confidence, and Computer Liking as well as the total of these three scores have been computed (Woodrow, 1990). These quantities are shown in Table 3. All of these quantities are in strong agreement with those obtained in Loyd and Gressard's (1984 and 1986) validity study of the Computer Attitude Scale when allowance was made for the fact that a four-item scale was used in the validation study, while a five-item scale was used in Woodrow's study (1990).

In particular as stated by Loyd and Gressard (1984) the results of the factor analysis for CAS showed high intercorrelation among the subscales, which indicated that all subjects were accounting for a large amount of common variance, and the reliability coefficient of the three subscales indicated that scales from each subscale were stable enough to be used separately. A further reliability test on the instrument by Koohang (1989), using 45 college students, indicated similar results.

Table 3: Intercorrelations among the three attitude dimensions of anxiety, confidence, and liking.

	Anxiety	Confidence	Liking	Total
Anxiety		0.803*	0.802*	0.924*
Confidence			0.841*	0.943*
Liking				0.942*
Total				

* $p < 0.01$.

TECHNICAL APPENDIX TWO

In discussing the measurement of stress and/or technostress, it is necessary to look for a subjective/introspective method from the mood/emotional point of view, in addition to or in the place of other conventional physiological methods. Also, since socio-psychological working environments and their changes can be sources of stress or change of stress levels, it is important to properly measure this stress and/or its changes as well as detect the factors responsible for inducing them (stressors).

Various stress measures have been developed and used in experimental psychology and in clinical settings. In King et al's view (1987), measurement of levels of stress is very important for mainly two reasons. The first relates to clinical situations where the measurement of stress is intended to help the clinician in the development and evaluation of a stress management programme.

The second use of stress measures is when the effects of stress on performance is studied and/or put under control. And it is this second use of stress measures that was applicable to the present study.

Also, for the second application (that is, assessing stress and performance) there is a need to measure arousal at the same time as stress, since it is only when both are measured that any sense can be made of the effects of mood on performance. However, tests which measure this additional mood dimension (i.e. arousal) are relatively rare in the literature.

The development of these specific mood measures (as part of psychological assessment) was also based on the assumption that people under stress (and/or arousal) will not only 'feel different' but that they will report these differences, too.

Thus, in King et al's view (1987), at least two different mood state responses can occur due to a perceived demand. These two responses were labelled 'stress' and 'arousal'. Although these two moods are distinct psychologically, they correspond to aspects of biophysiological changes which overlap to some extent. And although the evidence which points to the distinction between stress and arousal is substantial (e.g. King et al, 1983, 1987), the separation of the two constructs has often been ignored in the development of psychological measures of the stress. For example, Spielberger et al, (1970) described their concept of State Anxiety as including not only feelings of tension and apprehension, but also "heightened autonomic nervous system activity". This reference to autonomic nervous system activity sounds as if it refers to that part of the response which, by many researchers, including King et al (1983, 1987), has been called 'arousal'. However, and despite this problem, the actual scale itself (Spielberger et al, 1970) has been widely accepted as a valid and reliable measure of anxiety or stress.

In discussing stress and arousal, the suggestion that the two moods are independent is supported by work from a number of studies which found independent factors representing stress and arousal (e.g. King et al, 1983, 1987; Cox et al, 1977; Mackay et al, 1978, 1985, etc.). It was not only supported by the persistence of a near-zero correlation between accepted measures of stress and arousal, but also by the theoretical understanding of what these moods indicate with regard to people's reactions to life. According to King et al (1987),

"The two moods are, on average, independent which means that to know the value of one does not provide knowledge of the level of the other".

Indeed, in general, people with high stress may be highly aroused, or they may feel very flat, lifeless and devoid of resources: either of these alternatives could be considered, and in fact the independence of stress and arousal guarantees that examples of both will occur in a research study, on a group of subjects, involving those two factors.

So, the independence examined above holds true, on average, with a large group of people. However, this independence could not be expected for individual people. For example, someone may get highly excited and very active (in short, aroused) whenever he/she gets stressed, in a way that high arousal's coinciding with high stress can be predicted for that person. On the other hand, someone else may generally lose all initiative and vigour under the effects of stress, in a way that this becomes an enduring characteristic of that particular person. Thus, for some individual people there is a consistent trend for the two moods to change "in unison". This was shown in a King et al's study (1983) when a group of people filled in a stress and arousal questionnaire on each of seven successive days. The results showed that some people had a consistent negative relationship between stress and arousal: high stress meant low arousal and/or high arousal was related to low stress for them. On the other hand, others (fewer than the previous ones though) had a positive relationship with high stress being associated with high arousal and/or low arousal being associated with low stress.

Although this range of individual differences was established by several previous studies, it was firstly used and measured by King et al (1987) who provided a method of measuring an individual's stress-arousal relationship through the use of repeated measures. This was also important for the study of performance, since the actual level of a person's stress and arousal should be measured and known before it is possible to predict likely effects of either mood upon performance.

It should be noted here that the relationship between stress and arousal can be expressed as a correlation coefficient.

Following up the difficulty of distinguishing between stress and arousal, and in order to assess mood and mood changes induced within living and/or working environments, Cox and his colleagues developed an adjective check list which produced two factors, namely 'stress' and 'arousal' (Mackay et al, 1978). Cox's Stress/Arousal Adjective Check List (SACL) was initially based on the responses of a sample of British university students. Nevertheless, further studies by Cox (Cox et al, 1977), which show within-subject differences due to exposure to "stressors", supported the validity of the two factors (stress and arousal).

The use of mood adjective checklists (MACL) have been increasingly popular as a method of gathering data about an individual's phenomenological awareness of bodily processes and also about the behavioural and cognitive components of his/her reaction to different situations (MacKay et al, 1978).

One of the early instruments along these lines was described by Thayer (1967) for the measurement of self-reported 'activation'. In addition, several stress research studies, especially during the 80's, have employed the stress-arousal checklist developed by Mackay, Cox et al (1978), and Cox and Mackay (1985) and originally published in the British Journal of Social and Clinical Psychology (Mackay et al, 1978). Many researchers found it of value in describing their mood data in an economic way. Also, its further use in research was recommended by King and his colleagues (King et al, 1983).

Meddis (1969) hypothesised two basic components of mood: "hedonic tone", reflecting a general sense of well-being, and "vigour", which corresponds to the physiological concept of arousal. Similarly, from Cox and Mackay's point of view, the model of mood underlying the stress-arousal checklist was two-dimensional: One dimension was regarded to relate to feelings of unpleasantness / pleasantness or "hedonic tone" (stress) and the other to wakefulness / drowsiness or "vigour" (arousal). It was suggested by Mackay et al (1978) that the stress dimension was to reflect the internal response to the perceived favourability of the external environment, while the arousal factor could be seen as a representation of ongoing autonomic and somatic activity. Also, stress might partly reflect how appropriate the level of arousal could be for a given situation (Cox, 1982). This model of mood can also be found in other relevant psychological and psychophysiological literature (for example Mackay, 1980; Russell, 1980).

Studies carried out by several researchers (e.g. Burrows et al, 1977) indicated that the two dimensions (or factors) were differentially sensitive to a variety of environmental, task, and drug effects. In one study (Mackay and Cox, 1977), after a prolonged and monotonous repetitive task, a significant increase in self-reported 'stress' and a significant decrease in self-reported 'arousal' was found. A 'real life' stress situation, an intensive sales-training course

(Burrows, Simpson, and Cox, 1977), produced large changes in the stress scores as well as significant correlations between both factors (stress and arousal) and physiological measurements taken.

The original studies by Mackay et al (1978) used 45 adjectives derived from the work of Thayer (1967, 1978). From the results of those studies an early version of the checklist was developed using all the adjectives, but only scoring 34 of them, comprising 20 stress items and 14 arousal items. However, following early studies on normal adult working population (e.g. Burrows et al, 1977) four adjectives were excluded from the list of 34. So, the initial scales were soon replaced by a 30-adjective version (see Appendix 4), comprising 18 stress items and 12 arousal items. This last version adopted more stringent criteria for including adjectives - the ease with which the adjectives could be understood was also taken into account.

Besides, the factorial data on the previous adjective scales revealed the existence of two bipolar factors. Those factors were labelled as "stress" and "arousal". The adjectives comprising these factors together with the appropriate loadings are shown in the following Table.

Table: Adjectives loading on each factor
(Loadings below 0.40 are omitted)

Stress

Tense	0.75	Peaceful	-0.68
Worried	0.69	Relaxed	-0.77
Apprehensive	0.54	Cheerful	-0.64
Bothered	0.71	Contented	-0.73
Uneasy	0.72	Pleasant	-0.68
Dejected	0.59	Comfortable	-0.56
Up-tight	0.70	Calm	-0.68
Jittery	0.64	Restful	-0.55
Nervous	0.64		
Distressed	0.73		
Fearful	0.42		

Arousal

Active	0.71	Drowsy	-0.71
Energetic	0.75	Tired	-0.61
Vigorous	0.69	Idle	-0.54
Alert	0.63	Sluggish	-0.65
Lively	0.77	Sleepy	-0.75
Activated	0.66	Somnolent	-0.59
Stimulated	0.60	Passive	-0.56
Aroused	0.56		

Furthermore, even when the strongest of these items were selected (by King et al, 1983) to make a scale with 10 stress and 10 arousal items, a factor structure similar to that of the longer (30 items) SACL was reported. The scales obtained from the shorter version of SACL were so closely related with the values of the longer form that no psychometric advantage could be attributed to either the short or the long form.

Note, that the two stress scales have a correlation coefficient of 0.96, and the two arousal scales also have the same correlation, 0.96.

The SACL has been further studied and investigated in a wider range of contexts on Australian subjects (King et al, 1983). The results indicated that the scales were sufficiently robust that they could be confidently taken from one English-speaking population to another without significant changes to the psychometrics: The two factorially derived scales retained their orthogonality, and the real world meaning of the two scales was clarified: according to King et al (1983)

“..arousal may be regarded as a useful or appropriate aspect of the response to a perceived demand. Arousal was elevated in response to a high load cognitive demand, and was at its lowest among psychiatric patients...Stress was associated with perceived threat combined with a diminished belief in one's ability to cope...”.

In addition, Hinton (1989) used MacKay and Cox's (1978) “stress” scale, together with Spielberger's STATE anxiety inventory (STAI), in a number of studies involving stress generation. He subsequently found a very high correlation (0.93) between these two scales (with 83% similarity between questions. Close examination of the questions indicated that anticipatory fear feelings and worry constituted the “stress” measure (Hinton, 1989).

It seems likely that, while anxiety may be an important “feed-forward” in the stress model as proposed by Cox (1978), “stress” is a concept central to a situation of being involved in coping with perceived demands (furthermore, fear is by no means the only emotional stress response). Hinton's questionnaire (CAST: Cognitive Appraisal Stress Test of general

perceived coping incapacity) was actually based on Cox's view that stress is dependent on the discrepancy between perceived demands and perceived capability (Cox, 1978).

Furthermore, in considering the use of longer or shorter versions of the SACL, it should be noted that both stress and, particularly, arousal were regarded as VOLATILE mood states (King et al, 1987). For example, it was shown that speeded pencil and paper tests had a marked effect on arousal, usually elevating the score (King et al, 1983). It was therefore suggested that, because of the VOLATILITY of the mood state, the testing procedure might itself interact with the parameter which it purports to measure (King et al, 1987). Having said that, it is reasonable to conclude that a test procedure should be as short as possible, within the limitations of satisfactory statistical validity, in order to minimise possible test-induced interference.

The 30-adjective version of Cox and Mackay's SACL was used in this study (see Appendix 4). As mentioned previously, recommendations (King et al, 1983) and questions (Chruickshank, 1984) were raised concerning the structure, application and use of the 1978 checklist; in response, Cox and Mackay (1985) published another study on the effectiveness of this checklist in order to establish it as a reliable instrument (inventory) for the quick measurement of (self-reported) stress and arousal.

This version of the instrument provides for scores on two subscales: Stress (at this moment), and Arousal (at this moment). According to King et al (1983), the scale is also highly acceptable for repeated testing, as required in the present study.

Both 'stress' and 'arousal' subscales contain positively and negatively worded adjectives. Positively worded items on the Stress subscale comprise such adjectives as "tense" and "distressed", and negatively worded "relaxed" and "contented". On the Arousal subscale, positively worded items are such adjectives as "lively" and "energetic", and negatively worded "sleepy" and "drowsy".

Overall, out of thirty, thirteen of the items are content reversed. These adjectives are also listed in random order with no category designation given. Four different versions of the checklist were used where the adjectives were listed in a different random order, in order to prevent any biased result caused by the subjects remembering the order of the items.

In response to all items, subjects use the adjective list to describe their feelings or moods "at this moment". In particular, if the word (adjective) definitely describes how they feel at the moment they read it, subjects are asked to circle the double plus (++) to the right of the word; if the word only slightly applies to their feelings at this moment, they are asked to circle the single plus (+); if the word is not clear to them, or they cannot decide whether or not it applies to their feelings at the moment, subjects are asked to circle the question mark (?); and finally, if they clearly decide the word does not apply to their feelings at the moment, then

they are asked to circle the minus (-). In addition, participants are advised not to spend too long considering each word, as "first reactions are usually the most reliable"; however they are asked to be as accurate as possible.

For this study, it was decided that a choice of four responses would provide a sufficiently sensitive scale to indicate stress and arousal as well as any changes in them before and after computer interaction.

Also, in using mood scales, subjects appear to be considering both the certainty and the strength of their feelings (Bohlin and Kjellberg, 1973). The use of a '?' category by Mackay et al (1978) is therefore appropriate.

On the other hand, inability to report feelings may be symptomatic of a disordered psychophysiological state (Cox and Mackay, 1985). Thus, it may be useful, in some occasions, to acknowledge this possibility and score the frequency of the '?' responses. The split-half reliability coefficient for such a '?' was calculated, and is 0.89; this was similar to that for the other two scales (stress 0.80 and arousal 0.82) (Watts et al, 1983).

The recommended by the authors (Mackay, et al, 1978) method of scoring was as follows: If a (++) or (+) has been circled for a POSITIVE adjective then the score is 1, otherwise 0. If a (?) or (-) has been scored for a NEGATIVE adjective then the score is 1, otherwise 0. So, in other words, the responses for the positively worded items were recorded so that (++) = 1, (+) = 1, (?) = 0, and (-) = 0, whereas the responses for the negatively worded items were recorded oppositely, i.e. (?) = 1, (-) = 1, (++) = 0, and (+) = 0.

On the basis of these instructions scoring keys were easily made. By summing the items/adjectives scores on the respective subscales/dimensions, two total sub scores are obtained for each student, one score for each of the two subscales.

Item responses are coded so that a higher score corresponds to a higher degree of stress or arousal. Thus, scores on the Stress subscale range from 0 to 18, whereas scores on the Arousal subscale range from 0 to 12.

Several studies suggest that SACL is a reliable means of measuring stress and arousal in almost any type of subjects and situations. Therefore, it should be also reliable in measuring students' stress and arousal before and after computer interaction. In addition, the separation of mood into two separate but related entities (i.e. stress and arousal) is a logical and psychometrically well established proposition, also appropriate for this study. SACL takes less than five minutes to administer and complete. It appears to be a convenient and effective device for documenting stress and arousal "at this moment" together with any changes in stress and/or arousal as a result of an intervening activity (e.g. computer interaction).

CAS: Computer Attitude Scale

Loyd, B.H., and Gressard, C.P.

CODE NAME :

COMPUTER ATTITUDE SCALE

Here are a number of statements about your feelings towards computers. Please read each statement and circle the appropriate number according to how much you agree or disagree with the statement.

1 = strongly disagree 2 = disagree 3 = mildly disagree 4 = neutral
5 = mildly agree 6 = agree 7 = strongly agree

There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which best describes your feelings.

- | | |
|--|---------------|
| 1. Computers do not scare me at all. | 1 2 3 4 5 6 7 |
| 2. I'm no good with computers. | 1 2 3 4 5 6 7 |
| 3. I would like working with computers. | 1 2 3 4 5 6 7 |
| 4. A test on computer knowledge would scare me. | 1 2 3 4 5 6 7 |
| 5. Generally, I would feel OK about trying a new problem on the computer. | 1 2 3 4 5 6 7 |
| 6. The challenge of solving problems with computers does not appeal to me. | 1 2 3 4 5 6 7 |
| 7. I feel threatened when others talk about computers. | 1 2 3 4 5 6 7 |
| 8. I don't think I would do advanced computer work. | 1 2 3 4 5 6 7 |
| 9. I think working with computers would be enjoyable and stimulating. | 1 2 3 4 5 6 7 |
| 10. I feel aggressive and hostile towards computers. | 1 2 3 4 5 6 7 |
| 11. I am sure I could do work with computers. | 1 2 3 4 5 6 7 |
| 12. Figuring out computer problems does not appeal to me. | 1 2 3 4 5 6 7 |
| 13. I feel threatened by students who know something about computers. | 1 2 3 4 5 6 7 |
| 14. I'm not the type to do well with computers. | 1 2 3 4 5 6 7 |
| 15. If there is a problem with a computer run that I can't immediately solve, I would stick with it until I have the answer. | 1 2 3 4 5 6 7 |

16. Computers make me feel uncomfortable. 1 2 3 4 5 6 7
17. I am sure I could learn a computer language. 1 2 3 4 5 6 7
18. I don't understand how some people can spend so much time working with computers and seem to enjoy it. 1 2 3 4 5 6 7
19. I would feel at ease in a computer class. 1 2 3 4 5 6 7
20. I think using a computer would be very hard for me. 1 2 3 4 5 6 7
21. Once I start to work with the computer, I would find it hard to stop. 1 2 3 4 5 6 7
22. I get a sinking feeling when I think of trying to use a computer. 1 2 3 4 5 6 7
23. I could get good grades in computing courses. 1 2 3 4 5 6 7
24. I will do as little work with computers as possible. 1 2 3 4 5 6 7
25. I would feel comfortable working with a computer. 1 2 3 4 5 6 7
26. I do not think I could handle a computer course. 1 2 3 4 5 6 7
27. If a problem is left unsolved in a computer class, I would continue thinking about it afterward. 1 2 3 4 5 6 7
28. Computers make me feel uneasy and confused. 1 2 3 4 5 6 7
29. I have a lot of self-confidence when it comes to working with computers. 1 2 3 4 5 6 7
30. I do not enjoy talking with others about computers. 1 2 3 4 5 6 7
31. How would you best describe your typing skill?
Please ring the appropriate number.

1. None
2. Familiar with keyboard.
3. Fairly quick 'two finger' typing.
4. Adequate typing skills.
5. Fast touch-typing.

DCAS

Durham Computer Attitude Scale

CODE NAME

DURHAM COMPUTER ATTITUDE SCALE

Read each item carefully and underline quickly the phrase which best expresses your feeling about the statement. Whenever possible let your own personal experience determine your answer. Do not spend much time on any item. If in doubt, underline the phrase which seems most nearly to express your present feelings about the statement. Work rapidly. Be sure to answer every item.

1. When I use a computer I enjoy the experience.
Strongly agree Agree Undecided Disagree Strongly disagree
2. Computing helps me to think clearly and logically.
Strongly agree Agree Undecided Disagree Strongly disagree
3. I find computing very satisfying.
Strongly agree Agree Undecided Disagree Strongly disagree
4. Computer users forget how to communicate with other people.
Strongly agree Agree Undecided Disagree Strongly disagree
5. Learning to use computers is difficult.
Strongly agree Agree Undecided Disagree Strongly disagree
6. I find that I can be creative when I am computing.
Strongly agree Agree Undecided Disagree Strongly disagree
7. The benefits to be gained from learning to use a computer are well worth the investment of time and effort.
Strongly agree Agree Undecided Disagree Strongly disagree
8. I am apprehensive about using computers.
Strongly agree Agree Undecided Disagree Strongly disagree
9. Even simple problems can seem confusing if I try to do them on a computer.
Strongly agree Agree Undecided Disagree Strongly disagree
10. I find computing stressful.
Strongly agree Agree Undecided Disagree Strongly disagree
11. I find computing is often as complicated as learning a foreign language.
Strongly agree Agree Undecided Disagree Strongly disagree
12. Computing is tedious.
Strongly agree Agree Undecided Disagree Strongly disagree
13. I enjoy the intellectual challenge of using a computer.
Strongly agree Agree Undecided Disagree Strongly disagree
14. Computing outside of class hours is absorbing.
Strongly agree Agree Undecided Disagree Strongly disagree
15. Computing is interesting.
Strongly agree Agree Undecided Disagree Strongly disagree
16. I can sit down at a computer and lose all track of time.
Strongly agree Agree Undecided Disagree Strongly disagree
17. I find most commands easy to learn and remember.
Strongly agree Agree Undecided Disagree Strongly disagree
18. I often feel helpless in front of a computer.
Strongly agree Agree Undecided Disagree Strongly disagree
19. I find computers too impersonal.
Strongly agree Agree Undecided Disagree Strongly disagree
20. There's no fun in computing.
Strongly agree Agree Undecided Disagree Strongly disagree

Please turn over

Appendix Three: Initial and Final Instructions for completion of CAS and DCAS

3A

UNIVERSITY OF DURHAM,**Department of Psychology**

We are conducting a series of studies to investigate attitudes towards new technology and, in particular, students' attitudes towards computers. This first study is being carried out within the Department of Psychology and we are grateful for your participation. All the information you give will be entirely confidential, will not be included in any records and will be used only for research purposes.

To ensure that your participation is anonymous, we would like you to use a code-name. We would like you to make up your own code-name by taking the initial letter of your sex (i.e. M or F), followed by the date of birth of a friend or relative - one that you are familiar with and can easily remember.

For example:

1. *If you are female and you want to use your brother's birthday*

Sex F : Brother's Birthday 4th Dec 1966 : code name F041266

2. *If you are Male and you want to use your mothers birthday*

Sex M : Mother's Birthday 23rd Apr 1947 : code name M230447

Please use 01, 02 etc with numbers less than 10, so the code name always has six digits.

You will be asked for your code-name on several occasions and it is important that you use the same code-name each time, so please keep a private note of it.

Thank you very much for your help.

Vangelis Giannoutsos
David Kleinman

UNIVERSITY OF DURHAM,**Department of Psychology**

Thank you for having helped so far in our survey of students' attitudes towards computers. This is the follow up to the survey and we would like you to complete these final two questionnaires.

They will not take more than a few minutes to fill in. Please enter your code name on each. This will ensure that your participation is anonymous.

However, it is essential that this is THE SAME codename that you used on all the previous occasions, so that your responses can be compared with those taken earlier in the year.

To remind you, the code name consists of M (if you are male) or F (female), followed by a six digit code based on the birth date of a friend or relative (day, month, year).

For example:

1. *If you are female and you have used your brother's birthday*

Sex F : Brother's birthday 4th Dec 1966 : codename F041266

2. *If you are male and you have used your mother's birthday*

Sex M : Mother's birthday 23rd Apr 1947 : codename M230447

(Remember that you have used 01, 02 etc with numbers less than 10, so the code name always has six digits).

Thank you very much for your help.

Vangelis Giannoutsos

David Kleinman

Stress and Arousal Checklist (SACL)

(Four versions with different word orders)

Each of the following words describe feelings or moods. Please use the list to describe your feelings at this moment.

If the word definitely describes how you feel at the moment you read it, circle the double plus (++) to the right of the word. For example, if the word is RELAXED and you are definitely feeling relaxed at the moment, circle the double plus as follows:

RELAXED (++) + ? -

If the word only slightly applies to your feelings at this moment, circle the single plus (+) as follows:

RELAXED ++ (+) ? -

If the word is not clear to you, or you cannot decide whether or not it applies to your feelings at the moment, circle the question mark as follows:

RELAXED ++ + (?) -

If you clearly decide the word does not apply to your feelings at the moment, circle the minus (-) as follows:

RELAXED ++ + ? (-)

First reactions are usually the most reliable, therefore do not spend too long considering each word. However, try to be as accurate as possible.

RELAXED	++	+	?	-	TENSE	++	+	?	-
RESTFUL	++	+	?	-	ACTIVE	++	+	?	-
APPREHENSIVE	++	+	?	-	WORRIED	++	+	?	-
ENERGETIC	++	+	?	-	DROWSY	++	+	?	-
UNEASY	++	+	?	-	BOTHERED	++	+	?	-
DEJECTED	++	+	?	-	DISTRESSED	++	+	?	-
NERVOUS	++	+	?	-	VIGOROUS	++	+	?	-
PEACEFUL	++	+	?	-	TIRED	++	+	?	-
IDLE	++	+	?	-	UP-TIGHT	++	+	?	-
ALERT	++	+	?	-	LIVELY	++	+	?	-
CONTENTED	++	+	?	-	CHEERFUL	++	+	?	-
SLUGGISH	++	+	?	-	JITTERY	++	+	?	-
SLEEPY	++	+	?	-	PLEASANT	++	+	?	-
CALM	++	+	?	-	COMFORTABLE	++	+	?	-
ACTIVATED	++	+	?	-	STIMULATED	++	+	?	-

INSTRUCTIONS

PLEASE ENTER CODENAME _____

Each of the following words describe feelings or moods. Please use the list to describe your feelings at this moment.

If the word definitely describes how you feel at the moment you read it, circle the double plus (++) to the right of the word. For example, if the word is RELAXED and you are definitely feeling relaxed at the moment, circle the double plus as follows:

RELAXED (++) + ? -

If the word only slightly applies to your feelings at this moment, circle the single plus (+) as follows:

RELAXED ++ (+) ? -

If the word is not clear to you, or you cannot decide whether or not it applies to your feelings at the moment, circle the question mark as follows:

RELAXED ++ + (?) -

If you clearly decide the word does not apply to your feelings at the moment, circle the minus (-) as follows:

RELAXED ++ + ? (-)

First reactions are usually the most reliable, therefore do not spend too long considering each word. However, try to be as accurate as possible.

SLEEPY	++	+	?	-	UP-TIGHT	++	+	?	-
BITTER	++	+	?	-	RESTFUL	++	+	?	-
ENERGETIC	++	+	?	-	ALERT	++	+	?	-
CALM	++	+	?	-	CHEERFUL	++	+	?	-
TIRED	++	+	?	-	ACTIVE	++	+	?	-
DROWSY	++	+	?	-	APPREHENSIVE	++	+	?	-
QUIETLY	++	+	?	-	SLUGGISH	++	+	?	-
SOLE	++	+	?	-	PEACEFUL	++	+	?	-
STRESSED	++	+	?	-	DEJECTED	++	+	?	-
RELAXED	++	+	?	-	NERVOUS	++	+	?	-
CONTENTED	++	+	?	-	BOTHERED	++	+	?	-
SENSE	++	+	?	-	PLEASANT	++	+	?	-
UNEASY	++	+	?	-	WORRIED	++	+	?	-
FORGIVING	++	+	?	-	COMFORTABLE	++	+	?	-
ACTIVATED	++	+	?	-	STIMULATED	++	+	?	-

INSTRUCTIONS

PLEASE ENTER CODENAME _____

Each of the following words describe feelings or moods. Please use the list to describe your feelings at this moment.

If the word definitely describes how you feel at the moment you read it, circle the double plus (++) to the right of the word. For example, if the word is RELAXED and you are definitely feeling relaxed at the moment, circle the double plus as follows:

RELAXED (++) + ? -

If the word only slightly applies to your feelings at this moment, circle the single plus (+) as follows:

RELAXED ++ (+) ? -

If the word is not clear to you, or you cannot decide whether or not it applies to your feelings at the moment, circle the question mark as follows:

RELAXED ++ + (?) -

If you clearly decide the word does not apply to your feelings at the moment, circle the minus (-) as follows:

RELAXED ++ + ? (-)

First reactions are usually the most reliable, therefore do not spend too long considering each word. However, try to be as accurate as possible.

STIMULATED	++	+	?	-	APPREHENSIVE	++	+	?	-
NERVOUS	++	+	?	-	BOTHERED	++	+	?	-
DROWSY	++	+	?	-	SLUGGISH	++	+	?	-
DISTRESSED	++	+	?	-	ENERGETIC	++	+	?	-
TENSE	++	+	?	-	CALM	++	+	?	-
ALERT	++	+	?	-	CONTENTED	++	+	?	-
UP-TIGHT	++	+	?	-	WORRIED	++	+	?	-
SLEEPY	++	+	?	-	TIRED	++	+	?	-
LIVELY	++	+	?	-	IDLE	++	+	?	-
JITTERY	++	+	?	-	ACTIVATED	++	+	?	-
COMFORTABLE	++	+	?	-	UNEASY	++	+	?	-
VIGOROUS	++	+	?	-	RESTFUL	++	+	?	-
ACTIVE	++	+	?	-	CHEERFUL	++	+	?	-
DEJECTED	++	+	?	-	PLEASANT	++	+	?	-
PEACEFUL	++	+	?	-	RELAXED	++	+	?	-

INSTRUCTIONS

PLEASE ENTER CODENAME _____

Each of the following words describe feelings or moods. Please use the list to describe your feelings at this moment.

If the word definitely describes how you feel at the moment you read it, circle the double plus (++) to the right of the word. For example, if the word is RELAXED and you are definitely feeling relaxed at the moment, circle the double plus as follows:

RELAXED (++) + ? -

If the word only slightly applies to your feelings at this moment, circle the single plus (+) as follows:

RELAXED ++ (+) ? -

If the word is not clear to you, or you cannot decide whether or not it applies to your feelings at the moment, circle the question mark as follows:

RELAXED ++ + (?) -

If you clearly decide the word does not apply to your feelings at the moment, circle the minus (-) as follows:

RELAXED ++ + ? (-)

First reactions are usually the most reliable, therefore do not spend too long considering each word. However, try to be as accurate as possible.

TENSE	++	+	?	-	TIRED	++	+	?	-
RELAXED	++	+	?	-	IDLE	++	+	?	-
RESTFUL	++	+	?	-	UP-TIGHT	++	+	?	-
ACTIVE	++	+	?	-	ALERT	++	+	?	-
APPREHENSIVE	++	+	?	-	LIVELY	++	+	?	-
WORRIED	++	+	?	-	CHEERFUL	++	+	?	-
ENERGETIC	++	+	?	-	CONTENTED	++	+	?	-
DROWSY	++	+	?	-	JITTERY	++	+	?	-
BOTHERED	++	+	?	-	SLUGGISH	++	+	?	-
UNEASY	++	+	?	-	PLEASANT	++	+	?	-
DEJECTED	++	+	?	-	SLEEPY	++	+	?	-
NERVOUS	++	+	?	-	COMFORTABLE	++	+	?	-
DISTRESSED	++	+	?	-	CALM	++	+	?	-
VIGOROUS	++	+	?	-	STIMULATED	++	+	?	-
PEACEFUL	++	+	?	-	ACTIVATED	++	+	?	-

Lists of computer tasks for each practical sessions

PLEASE ENTER YOUR CODENAME _____

Psychology Computing Practical: Week 1

The list below shows the different tasks in PARTS 1-4 of this week's practical. As soon as you have finished, will you please go through the list below and for each task:

- a) Circle the task number on the LEFT if you COMPLETED it.
- b) For each task you TRIED (whether you completed it or not) please indicate how difficult you found it, by circling a number on the scale on the RIGHT. The scale ranges from 1 through to 5 where you should circle:
- 1 If you had no difficulty at all
 - 2 If you had only slight difficulty
 - 3 If you had a moderate amount of difficulty
 - 4 If you had fair amount of difficulty
 - 5 If you had a great deal of difficulty
- c) For any tasks you did not try, please indicate why.
eg: "ran out of time"; "unsure how to do it"; etc

Task	BRIEF DESCRIPTION OF TASK	No Diff				Very Diff
1.	Sign on, change password; sign off	1	2	3	4	5
2.	Create file MYNAME; edit with CURLEW; Copy it to end of file PSL0:NEWIDS; LIST PSL0:NEWIDS and destroy MYNAME	1	2	3	4	5
3.	Exercises on Curlew Tutorial Card	1	2	3	4	5
4.	Create a new file and give access to partner. Use CURLEW to prepare a short questionnaire.	1	2	3	4	5

PLEASE ENTER YOUR CODENAME _____

Psychology Computing Practical: Week 2

The list below shows the different tasks in PARTS 1-4 of this week's practical. As soon as you have finished, will you please go through the list below and for each task:

- a) Circle the task number on the LEFT if you COMPLETED it.
- b) For each task you TRIED (whether you completed it or not) please indicate how difficult you found it, by circling a number on the scale on the RIGHT. The scale ranges from 1 through to 5 where you should circle:

- 1 If you had no difficulty at all
- 2 If you had only slight difficulty
- 3 If you had a moderate amount of difficulty
- 4 If you had fair amount of difficulty
- 5 If you had a great deal of difficulty

- c) For any tasks you did not try, please indicate why.
eg: "ran out of time"; "unsure how to do it"; etc

Task	BRIEF DESCRIPTION OF TASK	No Diff					Very Diff	
1.	Sign on to MTS	1	2	3	4	5		
2.	Read all your incoming messages.	1	2	3	4	5		
3.	Use DIRECTORY command to find registered names	1	2	3	4	5		
4.	Compose and send a message to another member of the class.	1	2	3	4	5		
5.	Reply to a message or else forward a message	1	2	3	4	5		
6.	Quit	1	2	3	4	5		
7.	Signoff	1	2	3	4	5		

PLEASE ENTER YOUR CODENAME _____

Psychology Computing Practical: Week 3

The list below shows the different tasks in PARTS 1-4 of this week's practical. As soon as you have finished, will you please go through the list below and for each task:

- a) Circle the task number on the LEFT if you COMPLETED it.
- b) For each task you TRIED (whether you completed it or not) please indicate how difficult you found it, by circling a number on the scale on the RIGHT. The scale ranges from 1 through to 5 where you should circle:
- 1 If you had no difficulty at all
 - 2 If you had only slight difficulty
 - 3 If you had a moderate amount of difficulty
 - 4 If you had fair amount of difficulty
 - 5 If you had a great deal of difficulty
- c) For any tasks you did not try, please indicate why.
eg: "ran out of time"; "unsure how to do it"; etc

Task	BRIEF DESCRIPTION OF TASK	No Diff					Very Diff
1.	Get a printout (on the CANON printer) of one of your messages.	1	2	3	4	5	
2.	Check the registered name of someone in the class.	1	2	3	4	5	
3.	Use the MAILALIASES command to find aliases of members of the psychology department.	1	2	3	4	5	
4.	Use the MAILGROUPS command to find out what mail groupnames are available.	1	2	3	4	5	
5.	Use the MYGROUPS command to find out what mailgroups you belong to.	1	2	3	4	5	
6.	Construct your own file of mailaliases to use with EMU.	1	2	3	4	5	
7.	Reply to all the questionnaires you have received from other members of the class.	1	2	3	4	5	
8.	Discard messages that you no longer need to keep.	1	2	3	4	5	
9.	Copy EG:BELLMAN file. Use Curlew block mode to DELETE, MOVE and COPY verses.	1	2	3	4	5	

PLEASE ENTER YOUR CODENAME _____

Psychology Computing Practical: Week 4

The list below shows the different tasks in PARTS 1-4 of this week's practical. As soon as you have finished, will you please go through the list below and for each task:

- a) Circle the task number on the LEFT if you COMPLETED it.
- b) For each task you TRIED (whether you completed it or not) please indicate how difficult you found it, by circling a number on the scale on the RIGHT. The scale ranges from 1 through to 5 where you should circle:

- 1 If you had no difficulty at all
- 2 If you had only slight difficulty
- 3 If you had a moderate amount of difficulty
- 4 If you had fair amount of difficulty
- 5 If you had a great deal of difficulty

- c) For any tasks you did not try, please indicate why.
eg: "ran out of time"; "unsure how to do it"; etc

TASK	BRIEF DESCRIPTION OF TASK	No Diff					Very Diff
1.	Use ACCOUNT & FILESTATUS commands. Destroy unwanted files.	1	2	3	4	5	
2.	'Clean' your message file and check its size.	1	2	3	4	5	
3.	Copy EG:BELLMAN file. Use Curlew block mode to DELETE, MOVE and COPY verses.	1	2	3	4	5	
4.	Copy 'psl0:monday' etc. Use rectangular blocks to MOVE, DELETE and INSERT.	1	2	3	4	5	
5.	Use the STUDENT, DIARY and FILES commands.	1	2	3	4	5	
6.	Copy 'psl0:lyrprac.x4'. Use PAP to page the file and ask for single or double spacing.	1	2	3	4	5	
7.	Alter your file to indicate new page starts.	1	2	3	4	5	
8.	Insert underlines and check your document in the file '-PAGER'.	1	2	3	4	5	

Appendix Six

Subjective Stress Ratings

Here are some ratings which I would like you to fill in after the terminal session. Please circle the appropriate number in each case. These are followed by a couple of questions.

	strongly agree	agree	disagree	strongly disagree
The session was difficult.	1	2	3	4
The session was useful to me.	1	2	3	4
I felt in control of the situation.	1	2	3	4
I needed help.	1	2	3	4
I preferred to work it out for myself rather than ask for help.	1	2	3	4
I felt stressed.	1	2	3	4
I felt frustrated	1	2	3	4
I felt angry at the computer	1	2	3	4
Did you complete the session? (yes/no)			
Will you do some more computing (other than messaging) in your own time before the next session. (yes/no)			

Please name the Programs you used (eg EMU, MINITAB, CURLEW, WORD etc.).
Any additional comments would be welcome.

.....

Please write your codename here. (For cross reference only - all information will be treated as confidential).

.....

Thanks, Vangelis

Instructions for Completion of SACL, Task Lists & Stress Ratings**UNIVERSITY OF DURHAM, Department of Psychology**

We are conducting a series of studies to investigate attitudes towards new technology and, in particular, students' attitudes towards computers. At this stage we are looking at possible changes of mood caused by sessions at the computer in relation to the difficulty of specific computer tasks.

First of all, BEFORE you start any computing at all, I would like you to complete two questionnaires concerning attitudes towards computers. These should be filled out before you start any computing assignments.

Additionally, I would like you to fill in a set of four short questionnaires every time you have a session with the computer. Each of these sets consists of the following:

- a) **A short questionnaire about your feelings 'at this moment'.**
(this should be filled in IMMEDIATELY BEFORE each computer session)
- b) **A second short questionnaire about your feelings 'at this moment'.**
(this should be filled in IMMEDIATELY AFTER each computer session)
- c) **A list of computer tasks for each session.**
(to be filled in AFTER each computer session)
- d) **A list of ratings about your general reactions to each session's computing.**
(to be filled in AFTER each computer session)

So, in other words, I would like you to fill in ONE ('feelings') questionnaire BEFORE each computer session and THREE questionnaires AFTER, in the following order: the second 'feelings' questionnaire; the 'computer task' questionnaire; and the 'reactions' questionnaire.

This routine should be followed exactly for each of your computing practicals (i.e. four times within four weeks).

Wherever the questionnaires say CODENAME, please enter your codename as before. (Note that all the information you give will be entirely confidential, will not be included in any records, and will be used only for research purposes).

Please follow the instructions printed on each of the questionnaires. Then read each item carefully, and try to respond as quickly and accurately as you can. Remember though, that 1) there are no right or wrong answers, 2) your first reactions are usually the most reliable, so do not spend too long considering each item.

Finally, make sure that you have answered every item required on each questionnaire.

Thanks for your co-operation

With best wishes

Vangelis Giannoutsos

Levenson's Locus of Control Questionnaire

Please enter code number

A number of statements that people have made are given below. Read each statement, and then write a number from 1 to 7 indicating how much you think the statement applies to you. If it does - score 1, if not - score 7. There are no right or wrong answers. Do not spend too much time on any one statement, but give the answer which seems to describe your present feelings best.

1	2	3	4	5	6	7
Applies to me			Doesn't apply to me			

Example:

With "I like reading books." if you like reading books you would put a '2' (or 1 or 3 depending on how much you feel it applies to you), if you were undecided you would put a '4'; if you don't like reading books you would put a '6' (or 5 or 7).

Now mark your choices in the spaces on the left.

choice

- _____ 1) Whether or not I get to be a leader depends mostly on my ability.
- _____ 2) To a great extent my life is controlled by accidental happenings.
- _____ 3) I feel like what happens in my life is mostly determined by powerful people
- _____ 4) Whether or not I get into a car accident depends mostly on how good driver I am.
- _____ 5) When I make plans, I am almost certain to make them work.
- _____ 6) Often there is no chance of protecting my personal interest from bad luck happenings.
- _____ 7) When I get what I want, it's usually because I am lucky.
- _____ 8) Although I might have good ability, I will not be given leadership responsibility without appealing to those in positions of power.
- _____ 9) How many friends I have depends on how nice a person I am.

choice

_____ 10) I have often found that what is going to happen will happen.

_____ 11) My life is chiefly controlled by powerful others.

_____ 12) Whether or not I get into a car accident is mostly a matter of luck.

_____ 13) People like myself have very little chance of protecting our personal interests when they conflict with those of strong pressure groups.

_____ 14) It's not always wise for me to plan too far ahead because many things turn out to be a matter of good or bad fortune.

_____ 15) Getting what I want requires pleasing those people above me.

_____ 16) Whether or not I get to be a leader depends on whether I'm lucky enough to be in the right place at the right time.

_____ 17) If important people were to decide they didn't like me, I probably wouldn't make many friends.

_____ 18) I can pretty much determine what will happen in my life.

_____ 19) I am usually able to protect my personal interests.

_____ 20) Whether or not I get into a car accident depends mostly on the other driver.

_____ 21) When I get what I want, it's usually because I worked hard for it.

_____ 22) In order to have my plans work, I make sure that they in with the desires of people who have power over me.

_____ 23) My life is determined by my own actions.

_____ 24) It's chiefly a matter of fate whether or not I have a few friends or many friends.

Paulus Spheres of Control (SOC) Inventory

QUESTIONNAIRE TWO

A number of statements which people have made are given below. Read each statement, and then write a number from 1 to 7 indicating how much you think the statement applies to you. If it does - score 1 if not - score 7. There are no right or wrong answers.

Do not spend too much time on any one statement, but give the answer which seems to describe your present feelings best.

1 2 3 4 5 6 7
Applies to me / Doesn't apply to me

Example:
With "I like reading books." If you do like reading books you would put a "2" (or 1 or 3 depending on how much you feel it applies to you), if you were undecided you would put a "4", if you don't like reading books you would put a "6" (or 4 or 7).

Now mark your choices in the spaces on the left.

Choice

- 1) Usually I am considerate of other people's feelings.
- 2) When I have got what I have wanted it's usually because I worked hard for it.
- 3) I find it difficult to get people to do as I wish.
- 4) By taking an active part in political and social affairs, an individual can influence those affairs.
- 5) I would consider myself an anxious person.
- 6) When I have made plans they have usually worked out.
- 7) I have no trouble making and keeping friends.
- 8) Generally speaking people can have influence over the government.
- 9) Religion is an important part of my life.
- 10) I prefer games involving some luck over games requiring pure skill.
- 11) I'm not good at guiding the course of a conversation with other people.
- 12) It is difficult for people to have any control over the things big business does.
- 13) I can learn almost anything if I put my mind to it.
- 14) I can usually establish close personal relationships with people if I want to.

Codename

- 15) Bad economic conditions are caused by world events beyond our control.
- 16) My major accomplishments have been entirely due to my hard work and ability.
- 17) When being interviewed I can usually steer the interviewer toward the topics I want to talk about and away from those I wish to avoid.
- 18) Pressure groups can influence the government.
- 19) I have a quick temper.
- 20) I don't usually set myself goals because I find it difficult to see them through.
- 21) I find it difficult to get others to help me when I need it
- 22) One of the major reasons we have wars is that people don't take enough interest in politics.
- 23) Successful achievements are due to chance rather than own efforts.
- 24) I find that most people like me.
- 25) There is very little that consumers can do to keep prices down.
- 26) People consider me an aggressive person.
- 27) Often people get ahead just by being lucky.
- 28) I often find it hard to get my point of view across to others.
- 29) It is impossible to have any really important influence over what politicians do.
- 30) I usually succeed at the things I do.
- 31) In attempting to smooth over a disagreement I usually make it worse.
- 32) The people of Britain can do very little for the Third World.
- 33) It's pointless to keep working on something that's too difficult for me.
- 34) I find it easy to express myself in groups.
- 35) In the long run the voters are responsible for bad government.

Items (yes / no) from the EPI: Eysenck Personality Inventory

1. Do you often long for excitement?
2. Do you often need understanding friends to cheer you up?
3. Are you usually carefree?
4. Do you find it very hard to a no for an answer?
5. Do you stop and think things over before doing anything?
6. If you say you will do something do you always keep your promise, no matter how inconvenient it might be to do so?
7. Does your mood often go up and down?
8. Do you generally do and say things quickly without stopping to think?
9. Do you ever feel "just miserable" for no good reason?
10. Would you do almost anything for a dare?
11. Do you suddenly feel shy when you want to talk to an attractive stranger?
12. Once awhile do you lose your temper and get angry?
13. Do you often do things on the spur of the moment?
14. Do you often worry about things you should not have done or said?
15. Generally, do you prefer reading to meeting people?
16. Are your feelings rather easily hurt?
17. Do you like going out a lot?
18. Do you occasionally have thoughts and ideas that you would not like other people to know about?
19. Are you sometimes bubbling over with energy and sometimes very sluggish?
20. Do you prefer to have few but special friends?
21. Do you daydream a lot?
22. When people shout at you, do you shout back?
23. Are you often troubled about feelings of guilt?
24. Are all your habits good and desirable ones?
25. Can you usually let yourself go and enjoy yourself a lot at a lively party?
26. Would you call yourself tense or "highly-strung"?
27. Do other people think of you as being very lively?
28. After you have done something important, do you often come away feeling you could have done better?
29. Are you mostly quiet when you are with other people?
30. Do you sometimes gossip?
31. Do ideas run through your head so that you cannot sleep?

32. If there is something you want to know about, would you rather look it up in a book than talk to someone about it?
33. Do you get palpitations or thumping in your heart?
34. Do you like the kind of work that you need to pay close attention to?
35. Do you get attacks of shaking or trembling?
36. Would you always declare everything at the customs, even if you knew that you could never be found out?
37. Do you hate being with a crowd who play jokes on one another?
38. Are you an irritable person?
39. Do you like doing things in which you have to act quickly?
40. Do you worry about awful things that might happen?
41. Are you slow and unhurried in the way you move?
42. Have you ever been late for an appointment or work?
43. Do you have many nightmares?
44. Do you like talking to people so much that you never miss a chance of talking to a stranger?
45. Are you troubled by aches and pains?
46. Would you be very unhappy if you could not see lots of people most of the time?
47. Would you call yourself a nervous person?
48. Of all the people you know, are there some whom you definitely do not like?
49. Would you say that you were fairly self-confident?
50. Are you easily hurt when people find fault with you or your work?
51. Do you find it hard to really enjoy yourself at a lively party?
52. Are you troubled with feelings of inferiority?
53. Can you easily get some life to a rather dull party?
54. Do you sometimes talk about things you know nothing about?
55. Do you worry about your health?
56. Do you like playing pranks on others?
57. Do you suffer from sleeplessness?

Items from the type A sub-scale of the OSI.

Items are rated on six point scales from 6 - very strongly agree though to 1 - very strongly disagree. There is no neutral response available

- 1 Because I am satisfied with life I am not an especially ambitious person who has a need to success or progress with their career
- 2 My impatience with slowness means for example that when talking to other people my mind tends to race ahead and I anticipate what the person is going to say
- 3 I am a fairly confident and forceful individual who has no qualms about expressing feelings or opinions in an authoritative and assertive manner
- 4 I am not an especially achievement oriented person who continually behaves in a competitive way or who has a need to win or excel in whatever I do
- 5 When I am doing something I concentrate on only one activity at a time and am fully committed to giving it a 100% of my effort
- 6 I would describe the manner of my behaviour as being quote challenging and vigorous
- 7 When I compare myself with others I know, I would say that I am more responsible, serious conscientious and competitive than they are
- 8 I am usually quite concerned to learn about other people's opinion of me particularly recognition others give me
- 9 Even though I take my job seriously, I could not be described as being completely and absolutely dedicated to it.
- 10 I have a heightened pace of living in that I do things quickly such as eating, talking and walking and so on.
- 11 When I am establishing priorities, work does not always come first because although it is important, I have other outside interests which I also regard as important
- 12 I am a fairly easy going individual, who takes life as it comes and who is not especially 'action oriented'.
- 13 I am a very impatient sort of person who finds waiting around difficult especially for other people
- 14 I am time conscious and lead my life on a 'time is money and can't be wasted' principle

Instructions for Completion of Personality Questionnaires**UNIVERSITY OF DURHAM,****Department of Psychology**

Thank you for having helped so far in our survey of students' attitudes towards computers. This is part of the follow up to the survey and we would like you to complete this set of questionnaires.

There are four questionnaires, but they should not take too long to fill in. Please enter your code name on each. This will ensure that your participation is anonymous.

However, it is essential that this is THE SAME codename that you used on all the previous occasions, so that your responses can be compared with those taken earlier in the year.

To remind you, the code name consists of M (if you are male) or F (female), followed by a six digit code based on the birth date of a friend or relative (day, month, year).

For example:

1. *If you are female and you have used your brother's birthday*

Sex F : Brother's birthday 4th Dec 1966 : codename F041266

2. *If you are Male and you have used your mother's birthday*

Sex M : Mother's birthday 23rd Apr 1947 : codename M230447

(Remember that you have used 01, 02 etc with numbers less than 10, so the code name always has six digits).

Please note that since you will be asked for your code-name on more occasions, it might be helpful to keep a private note of it.

Thank you very much for your help.

Vangelis Giannoutsos
David Kleinman

Appendix Thirteen: A brief review of recent literature on attitudes and personality in computing (1993-2003)

Introduction

Due to delays outside of my control, this Appendix provides a summary of recent supplementary information.

As reported in my thesis, research generally demonstrates that experience with, or exposure to computers is positively related to attitudes. Other research studies demonstrate that computer experience, both the type as well as the amount, is associated with lower levels of computer anxiety. These findings suggest that experience with computers leads to positive attitudes towards them, and to a reduction in anxiety related to present or future use of computers. The relevant studies have either correlated reported prior amount of computer experience with attitude / anxiety scores or measured changes in computer attitude/anxiety levels as a consequence of completing some type of computer course.

In considering research that correlated subjects' reported prior experience with their attitude / anxiety scores, most studies have found a positive relation between computer attitude and prior experience, and a negative relation between computer anxiety and prior experience (e.g. Levine et al, 1997, 1998; Levin and Gordon, 1989; Koohang and Byrd, 1987; Loyd, Loyd, and Gressard, 1987; Todman and Monaghan, 1994; Maurer, 1994; Rosen and Weil, 1995; Mahmood and Medewitz, 1989; Jay, 1985; Ray and Minch, 1990; Marcoulides, 1988; Heinssen et al, 1987).

In considering research that measured changes in computer attitude / anxiety levels as a consequence of completing some type of computer course, there is evidence that undertaking any of a range of different types of computer training leads to improved computer attitude and decreased computer anxiety. Thus, there is a substantial number of pre-test/post-test studies reporting a positive relation between computer attitude and computer experience through training, and a negative relation between computer anxiety and computer experience (e.g. Gressard and Loyd, 1985; Harrington et al, 1990; Brown and Coney, 1994; Czaja and Sharit, 1998; Igbaria and Chakrabarti, 1990, etc).

Although these studies provide mainstream conclusions, in that they suggest that computer attitude improves and computer anxiety reduces as a function of experience gained from some type of computer course, other studies present complications and exceptions indicating that the relation between computer attitude/anxiety and computer experience (provided through training) can be more complex (e.g. Rosen et al, 1987; McNerney et al, 1994; Leso and Peck, 1992; Koslowsky et al, 1987; Woodrow, 1994; Temple and Gavillet, 1990; Chu and Spires, 1991; Lambert, 1991, etc).

Similarly, more recent studies have either examined the relationship between subjects' prior computer experience with their computer attitude / anxiety or measured changes in computer attitude/anxiety levels as a consequence of completing a type of computer training course. In addition, some of the most recent studies have looked at the relationship of prior experience with Internet attitude/anxiety levels or measured changes in Internet attitude/anxiety levels as a consequence of completing a type of a training course related to the Internet.

The correlation between computer attitude and prior computer experience and the correlation between computer anxiety and prior computer experience are the most consistent findings. In general, the patterns are similar to those emerging from previous literature, as reviewed and discussed within my PhD thesis: the higher the levels of prior computer experience, the more

favourable the computer attitudes and the lower the levels of computer anxiety. For example, Liaw (2002), Schumacher and Morahan-Martin (2001), and McIlroy et al (2001) showed the positive relation between attitudes and prior experience, whereas Hasan (2003) showed the positive relation between self-efficacy and prior experience.

These results were echoed in the relationship between prior experience and Internet attitudes. So, similarly, prior experience was found to be positively related to Internet attitudes, and, in turn, Internet attitudes were found to be strongly related with computer attitudes (e.g. Liaw, 2002; Schumacher and Morahan-Martin, 2001).

In considering studies that have measured changes in attitude or self-efficacy as a consequence of completing a type of computer course, Torkzadeh and Dyke (2002) found that Internet self-efficacy levels increased significantly from before to after an introductory computer training course. However, no significant difference was found between pre-training and post-training computer attitudes.

Similarly, recent studies found computer anxiety to be inversely related to prior experience (e.g. Chua et al, 1999; McIlroy et al, 2001; Shelley, 1998), and Brosnan (1999) found that lower levels of computer anxiety were associated with higher levels of computer usage.

A representative and indicative sample of some recent empirical studies will be reported in some detail below. The criterion of selection was their contextual similarity to the research presented and discussed within my PhD thesis. The intention was that these studies illustrate some of the main issues currently arising in the area. Some emphasis was given to the details of the measures used.

The first part of this review includes recent studies of computer and Internet attitudes in relation to computer experience, followed by recent research on computer anxiety in relation to experience. Subsequently, a study on computer experience on its own will be discussed. At this point, it should be noted that while a large part of the literature sees computer anxiety as a significant part of computer attitudes, another part tends to define and assess computer anxiety independently.

The second part of this review looks at the most recent research on personality in relation to computer attitudes, anxiety and use.

A. Computer Attitudes, Anxiety, and Experience

Computer Attitudes and Experience

Liaw (2002) attempted to investigate the relationship between computer attitudes and Internet attitudes, and to find predicting variables for both types of attitudes. This study is important because: a) Attitudes towards computers have been defined and assessed separately from attitudes towards the Internet b) The relationship between computer attitudes and computer experience have been assessed separately from the relationship between attitudes towards the Internet and experience, and c) Carefully selected and well established measures were used to assess attitudes towards computers and attitudes towards the Internet. Moreover, the computer experience measure was compatible with both kinds of attitudes.

A set of questionnaires was sent, via the Internet, to 809 students enrolled in courses at Seattle Pacific University. Only 260 subjects returned the completed questionnaires.

Internet attitudes were measured by the Web Attitude Scale (WAS), which was based on the Technology Acceptance Model (TAM) (Davis et al, 1989; cited in Liaw, 2002). This measure assumes that intention to use technologies are mainly based on perceived ease of use and

perceived usefulness. Venkatesh (1999) defines perceived ease of use as the extent to which a person believes that using a technology will be free of effort (process expectancy). Perceived usefulness is defined as the extent to which a person believes that using a technology will enhance their productivity (outcome expectancy). The WAS has been used to collect information about liking, perceived usefulness, and intention to use and learn the Internet. WAS, for this study, consisted of 16 items, in a seven-point Likert format from "strongly disagree" to "strongly agree".

Computer attitudes were measured by the Computer Attitude Scale (Lloyd and Gressard, 1984, 1986). A modified 16-item version was used in this study, in a 7-point Likert format from "strongly disagree" to "strongly agree".

Finally, subjects were asked to provide information about computing experience. In particular, they were asked to indicate the amount of experience they had in using computers, using the Internet or the World Wide Web, experience with word processors, database packages, and computer programming languages. A seven-point Likert type format scale was used, from "no experience" to "high experience". Subjects were also asked to report the number of years of computing experience.

There was a high and significant correlation between the CAS and the WAS. Thus, a positive significant relationship was found between computer attitudes and Internet attitudes. Also, all types of computer experience (amount of experience in using computers, using the Internet or World Wide Web, experience with word processors, database packages, computer programming, as well as reported years of computing experience) were found to be significantly and positively correlated with both computer attitudes (as measured by CAS) and Internet attitudes (as measured by WAS). Finally, subjects who reported more than six or more years of computer experience had the most favourable attitudes both towards computers and towards the Internet.

Moreover, stepwise regression analysis showed that experience in using computers, experience in using the Internet, and experience with word processors, were the predictors of computer attitudes. Similarly, experience in using the Internet and experience with word processors were the predictors of WAS (i.e. the predictors of attitudes towards the Internet).

In conclusion, subjects, who have more positive attitudes towards computers, also have more positive attitudes towards the Internet. And, prior computer experience not only has a positive effect on computer attitudes but also on attitudes towards the Internet. However, since the collection of data for this study was conducted via the Internet, there is a possibility that students who responded may have had more positive attitudes towards computers and the Internet, compared to students who did not respond.

Finally, it is important to note that the close relationship between computer attitudes and Internet attitudes may provide evidence that the CAS (or at least its modified version used for this study) could be used also as a measure of attitudes towards the Internet.

Schumacher and Morahan-Martin (2001) investigated whether attitudes, computer experience, skills and Internet use are related.

The subjects were incoming undergraduate college students in the years 1989, 1990, and 1997. On all three occasions, a survey was conducted asking questions about general computer use, computer use in specific applications, level of skill, and amount of experience with different computer applications. For year 1997 only, questions were added to assess Internet (including email) use, computer attitudes, and attitudes towards the Internet.

Experience level in various applications was assessed by asking subjects to rate the amount of experience they had in various applications (little or none, some, more than average, a lot). In 1989 and 1990, the applications were: IBM PC or compatible, the Apple computer, a Macintosh, word processing, spreadsheets, accounting programs, computer programs, and playing computer games. For the year 1997, the last five applications were the same, but the first three were replaced with the following two: using the Internet, and sending and receiving email.

For 1997 only, computer attitudes were assessed by two Likert type questions measuring the degree of competency and comfort towards computers, and two measuring the degree of competency and comfort towards the Internet.

Analysis of variance (ANOVA) was run on data from surveys in years 1989 and 1990. It was found that the year of the survey had no significant effect on any of the variables. Thus, data from 1989 and 1990 survey were combined and analysed together.

According to the data, in 1989/1990 more than 90% of the subjects had used computers in high school, 80% had taken a course involving the use of computers, and approximately 50% had used a computer at home. Computer experience was increased in 1997: 99.6% of the subjects had used computers in high school, 93% had used computers in a course, and 87% had used computers at home. In spite of this increase, not all skills and experience were increased in 1997. In particular, although there was an increase in level of skill in typing and experience in playing computer games, there was actually a decrease in the level of skill in programming and experience in writing computer programs.

Moreover, in 1997, subjects had more experience and skills with computers than with the Internet. In particular, all subjects had used computers while 86% had used the Internet, World-Wide-Web, or email. Subjects were also found more likely to have taken a high school course involving the use of computers (93.4%) than a course involving the use of the Internet (29.6%). Subjects used computers more hours per week (average 9.49 hours) than the Internet (average 6.14 hours). Moreover, subjects had higher scores on Computer Comfort/Competency (the computer attitude measure) than on Internet Comfort/Competency (the Internet attitude measure). And a large minority of subjects were found to lack competency and comfort with both computers (19%) and the Internet (36%). The two attitude measures were found to correlate to each other highly and significantly. Finally, further analysis indicated that those subjects who had high scores on Computer Competence and Internet Competence also had higher level of skill and experience, indicating that experience was positively related to both computer attitude and Internet attitude.

According to Bandura (1977), self-efficacy relates to a person's belief in his/her capability to perform a task. Bandura (1977, 1986) also suggests that expectations of personal efficacy derive from four sources of information: a) performance accomplishments, b) vicarious experience, c) verbal persuasion, and d) emotional arousal. Bandura also assumes that self-efficacy has three components: a) magnitude, the levels of task difficulty that people believe they can achieve, b) strength, the intensity of belief regarding magnitude, and c) generality, the extent to which the belief is generalised across situations. Thus, the concept of self-efficacy is influenced by individual differences and arises from the gradual acquisition of cognitive, social, and/or physical skills through experience, and as such, is a dynamic construct that changes over time as new information and experiences are acquired (Bandura, 1982).

According to Compeau and Higgins (1995), computer self-efficacy is an individual judgment of a person's capability to use a computer. Thus, when students start a computing course, their initial self-efficacy must be mainly influenced by their current abilities, attitudes, and prior computer experience.

Hasan (2003) investigated the influence of computer experience on computer self-efficacy beliefs. The advantage of this study is that the unique effect of eight specific types of computer experience on computer self-efficacy is examined. Thus, eight types of computer experience are defined and measured: word processing, spreadsheets, databases, operating systems, computer graphics, computer games, telecommunications, and programming.

Subjects were 151 part-time and non-traditional students enrolled in sections of a four-year computer information system course at a US public institution. Computer self-efficacy beliefs were assessed by nine items adapted from Compeau and Higgins' (1995) scale of self-efficacy, and were used to measure subjects' confidence in their computing skills. Subjects were asked to rate their confidence on a 10-point scale ranging from 1 (= 'not at all confident') to 10 (= 'totally confident'). Experience with word processing, spreadsheets, databases, operating systems, computer graphics, computer games, telecommunications, and programming were measured by a 10-point scale ranging from 1 (= 'no experience') to 10 (= 'very experienced').

Subjects reported the highest levels of computer experience in word processing and computer games. The lowest levels of computer experience were reported in computer programming. Multiple regression analysis revealed that experience with programming and graphics had the strongest significant impact on self-efficacy beliefs. Experience with word-processing had a marginally significant effect whereas all other computer applications had low and non-significant effects. However, all eight types of computer experience did correlate positively with self-efficacy beliefs. Moreover, about 42% of the variance in self-efficacy beliefs was found to be explained by the eight types of computer experience.

Torkzadeh and Dyke (2002) investigated the influence of training programs on user attitudes towards computers and Internet self-efficacy. This is a pre-test/post-test study that measures changes in attitudes towards computers and Internet self-efficacy as a consequence of completing a type of computer training course. Experience, in this context, is not defined or measured as 'prior', but it refers to this particular course. The authors also examined the influence of attitudes towards computers on Internet self-efficacy.

The subjects were 189 students who attended several sections of an introductory course to computers at a US university. Computer attitudes were assessed by a measure developed by Popovich, Hyde, Zakrajsek, and Blumer (1987) to examine attitudes towards computer usage both before and after computer training. This scale consists of 20 items, in a five-point Likert type format (1=strongly disagree to 5=strongly agree), that reflects four factors: a) negative reaction to computers, b) positive reaction to computers, c) computers and children education, and d) reaction to computer related mechanism.

Internet self-efficacy was assessed by a measure developed by Torkzadeh and Van Dyke (2001). This scale consists of 17 items in a five point Likert type format (1=strongly disagree to 5=strongly agree), and measures Internet self-efficacy in terms of three factors: browsing (3 items), encryption/decryption (6 items), and system manipulation (8 items). Both the computer user attitude and the Internet self-efficacy scales were administered during the first week of a computing training course, and then, for the second time, during the last week of the course.

Data were analysed in order to examine whether there was any change of students' self-efficacy from before to after the introductory training course. Thus, pre- and post-training scores were compared to each other. The results suggested that subjects started the course with relatively high levels of Internet self-efficacy. And self-efficacy levels were found to significantly increase after the course. In particular, the differences between pre- and post-training Internet self-efficacy scores were found to be significant for all three Internet factors measured. Also, students were found to be more comfortable with browsing the Internet than encrypting/decrypting or manipulating the system.

Data were also analysed in order to examine whether there was any change of students' attitudes towards computer usage from before to after the introductory computing course. Overall, computer attitude scores were high. However, no significant difference was found between pre-training and post-training attitudes. Thus, it was concluded that training did not seem to influence attitudes towards computer usage.

Further analysis of data was performed to assess the influence of attitudes towards computer usage on Internet self-efficacy. Subjects were grouped as having 'high' or 'low' attitudes towards computer usage by using, as threshold, the mean score on the pre-test attitude scale. Internet self-efficacy was found to be significantly different for subjects with 'high' and 'low' attitudes, in that 'high' attitude subjects had higher self-efficacy scores than 'low' attitude subjects for all three Internet factors measured (i.e. browsing, encryption/decryption, and system manipulation). It was also found that Internet self-efficacy for subjects with both 'high' and 'low' attitudes improved with training. However, 'high' attitude subjects had a greater improvement in Internet self-efficacy than 'low' attitude subjects.

Computer Anxiety and Experience

Chua, Chen and Wong (1999) conducted a meta-analytic study on the relationship between computer anxiety and computer experience. Computer anxiety is defined as a fear of computers when using them or when considering the possibility of using them. In this context, computer anxiety is regarded as a type of 'state anxiety', which can be changed, and usually causes avoidance of computer use. Computer experience can be a computer course, computer training, hands-on computer experience, ownership of computer at work or at home, computer games experience, etc. Measures of computer experience can be the frequency of computer use at work or at home, the number of years using computers, the number of computer courses previously attended, number of computer course hours, etc. As expected, Chua et al's meta-analytic overall results indicate that computer anxiety is inversely related to computer experience. However, there was no common agreement among the studies involved about the extent to which computer anxiety is related to computer experience. This may be explained by the different measures used to assess computer anxiety across studies investigating its relation to different types of computer experience. This issue will be further explored within the next ('Computer experience') section.

McIlroy, Bunting, Tierney, and Gordon (2001) investigated background experience in relation to computing anxiety, attitudes and cognitions.

The subjects were 193 first year undergraduate social science students (mostly enrolled in psychology courses) from three campuses at the University of Ulster. Computer anxiety was assessed by CARS (Computer Anxiety Rating Scale) (Rosen and Weil, 1992). This questionnaire consists of 20 items in five point Likert format, that reflect: a) anxiety related to the machines themselves, b) their role in society, c) computer programming, d) computer use, and e) problems with computers and technology. Cognitions were assessed by the CTS (Computer Thoughts Survey) (Rosen and Weil, 1992). This also consists of 20 items, in five point Likert format that entail: negative computer cognitions, positive computer learning cognitions, and computer enjoyment.

The rest of the variables involved were all coded in a categorical form as "0" and "1". These variables included: computing pass in GCSE, regularity of access to computing facilities outside university, characteristics of initial computing instructor (e.g. nervous or confident, and competent or incompetent), familiarity with computers, and whether first computing experience was positive or negative.

Analyses of data indicated that the more positive attitudes towards computers and the lower levels of computer anxiety, were in those who had regularity of access to computing facilities outside university, in those who had a positive first computing experience, in those who perceived that their initial computing instructor was competent, and in those who had a computing pass in GCSE.

It is interesting to note that only four students reported no familiarity with computers prior to university. Thus, it is evident that the vast majority of social science students at the University of Ulster started their university studies with some kind of previous experience with computers. Since proliferation of computers and computer use continues to increase in all levels of education (Selwyn, 2000), the pattern of starting university with some, at least, prior computing experience can be considered to be the norm. This trend may be reflected in studies of the impact of previous to university computing experience on students' computer attitudes and anxiety, in that comparisons with a 'naïve' group of computer beginners may be, at a university level, difficult or impossible.

Shelley (1998) reported that foreign language teachers were influenced in adopting an innovative email system by factors including email instruction, hands-on email experience, prior experience and individual level of computer anxiety.

Subjects were 159 foreign language teachers representing a broad geographical, language, and teaching-level range. A self-report questionnaire was developed by the researcher and included questions assessing prior computer experience, and amount of email use. Some of the teachers received email instruction and hands-on experience (experimental group), while others did not (control group). The measure of computer anxiety used for this study was the Computer Anxiety Index (CAIN; Simonson, Maurer, and Torardi-Montag, 1987).

Results indicated that teachers who received email instruction and had hands-on experience (during four workshops) were found to use the email system significantly more than comparable teachers who did not receive instruction or have hands-on experience. In addition, the greater the prior experience and the lower the level of computer anxiety, the more likely the teachers were to adopt and use the email system.

Brosnan (1999) conducted a study with the aim to investigate which factors best predicted word-processor usage. The subjects (147 undergraduate psychology students) were monitored over a 13-week semester and were asked to complete a series of questionnaires at the beginning and the end of this period. The Computer Anxiety Rating Scale (CARS) (Heinssen et al, 1987) was used as a measure of computer anxiety. Computer attitudes were assessed by Todman and Dick's (1994) 11-item questionnaire, which consists of three subscales: perceived usefulness, perceived ease of use, and perceived fun. Computer self-efficacy was measured by Hill et al's (1987) 4-item scale asking specifically about confidence with computers. In addition, word-processing usage and expected usage was measured by a 7-point scale (e.g. Davis et al (1989).

A stepwise multiple regression analysis, followed by path analysis, showed that computer self-efficacy predicted computer anxiety. Levels of computer anxiety predicted computer usage at the beginning of the semester and perceived usefulness of computers. Finally, computer usage at the beginning of the semester, expected usage, and perceived usefulness predicted self-reported word-processor usage over the 13-week semester. Brosnan (1999) related his study and findings to the Technology Acceptance Model (Davis, 1986, 1993, and Davis et al, 1989), as well as to Bandura's self-efficacy theory including computer self efficacy and computer anxiety (Bandura, 1977, 1986).

Computer experience

One of the first attempts to conceptualise and measure computer experience was made by Heinssen, Glass and Knight (1987) who developed the Computer Experience Questionnaire (CEQ). This was a checklist of 27 items indicating computer use at work, school, and home environments. Although Heinssen et al provided no information about validity or reliability of their measure, the scale has been used in several studies.

Potosky and Bobko (1998) attempted to review the construct and measurement of computer experience. They argued that experience with computers has been, if at all, inconsistently defined and measured within the literature. And they pointed out that a more consistent measure of computer experience may improve the validity of the findings in studies examining the impact of computer experience on computer attitudes and anxiety, and will make comparisons of these studies easier. Potosky and Bobko define computer experience as "the degree to which a person understands how to use a computer". This definition may cover a wider spectrum of computer experience compared to alternative existing approaches to determining computer experience, such as measures using just frequency or duration of use (e.g. Gardner et al, 1993), programming skill, or the number of computer courses taken.

In an attempt to provide an answer to issues mentioned above, Potosky and Bobko (1998) developed their own measure of computer experience, the Computer Understanding and Experience Scale (CUE). This is a self-rated assessment of one's "know-how" about using a computer, by measuring knowledge in conducting a variety of general computer uses. The subjects were 279 mainly students enrolled in courses at different educational institutions, but also some computer programmers and other full-time employees in positions requiring high levels of computer experience and use.

The CUE scale was used. This consists of 12 items, in five point Likert format (strongly disagree to strongly agree), that ask subjects to rate their knowledge of various use of computers, the extent to which they use computers for particular reasons, and how good they perceive themselves to be in using computers. Items reflect overall knowledge about computers, more focused task performance, and overall self-assessment. Note that, in this context of measurement, the concept of computer experience seems, to a certain extent, to overlap with the concept of computer self-efficacy, as previously defined and discussed.

Subjects were also asked to rate their knowledge of computers on a scale of 1 (very minimal) to five (extensive). They were also asked several computer background questions, such as whether they owned a computer, if they ever took a course in computer programming, if they ever took an academic or job-training course in word processing, if they ever took a test or exam using a computer, if they ever used computers in a network, and if they used computers in a computer laboratory. Subjects were finally asked to indicate how many hours per day they spent working at a computer, and to provide some basic demographic information.

Analysis of data indicated that CUE and its sub-scales were significantly and positively correlated with subjects' ratings of their knowledge of computers, computer ownership, hours per day spent working at a computer, whether a person had taken a course in computer programming or word processing, whether a person had used network computers or used a computer in a computer laboratory, and if a person had taken a test or exam using a computer. Thus, any experience or training in using computers was found to be positively and significantly correlated with CUE scores and sub-scores. However, and as expected, the CUE and its sub-scales was not found to be significantly correlated with the age of the subjects.

Although the CUE scale appears to be a convenient and construct-wise valid measure of computer experience, it is a self-report scale and does not seem to consider more 'objective' approaches of measurement of the construct. Moreover, computer experience may need to be treated as an evolving construct because of the speed with which computer technology evolves

(Potosky and Bobko, 1998), in that a complete measure of computer experience nowadays should include items on Internet experience of use.

B. Personality and Computing

This report will mainly discuss studies about the relation between the personality dimensions of extraversion and neuroticism with computer/Internet attitudes and use. This is mainly because these two personality variables are not only investigated and discussed within my PhD thesis but also are studied to some extent within the most recent literature on personality and computing. Studies investigating the relation between locus of control and attitudes or A Typology and attitudes seem to be scarce within recent literature. However, other personality variables, such as openness, agreeableness, conscientiousness and loneliness, seem to be more apparent in recent studies.

As reported in my thesis, firstly, four empirical studies have investigated whether extraversion contributes to predicting general computer programming achievement (Chin and Zecker, 1985; Kagan and Douthat, 1985; Kagan and Esquerra, 1984; Newsted, 1975). Three out of these four studies did not find extraversion related to computer programming, whereas Kagan and Esquerra, (1984) found that extraversion was negatively correlated with achievement on FORTRAN exams. However, the large difference in sample size, the varying results, and the different instruments in some cases used, prevent one from making any definite or reasonable conclusions regarding the relation between extraversion and computer programming achievement.

Subsequently, a small set of studies started to look at the relations between Eysenck's dimensional model of personality and computer-related attitudes. Research suggests that a positive attitude towards computers is inversely related to computer anxiety (e.g. Gressard and Loyd, 1986), while specific anxieties tend to be related to trait anxiety and to the underlying personality dimension of neuroticism (Francis, 1993). These relations suggest a negative correlation between neuroticism and computer-related attitudes. Although this hypothesis is supported by the findings of Sigurdsson (1991), Katz and Offir (1991), and Katz (1993), it is not, however, supported by Egg and Meschke (1989), by Katz and Francis (1995), Francis (1995), or by Francis, Katz, and Evans (1996), except in relation to the specific construct of computer anxiety.

Research suggests that a positive attitude towards computers may reflect a preference for solitary activities and an avoidance of social interaction (e.g. Alspaugh, 1972), while extraversion is clearly characterised by sociability, a preference for group activities and an avoidance of solitary activities (Eysenck and Eysenck, 1975). These relations suggest a negative correlation between extraversion and computer-related attitudes. This is consistent with Bozeman's (1978) findings, which supported some degree of relation between extraversion and apprehension of computer technology, with Katz and Offir's findings, and with Francis, Katz and Evans (1996) findings. On the other hand, Egg and Meschke (1989), Sigurdsson (1991), Katz and Francis (1995), Francis (1995), and Katz (1993) found neither a positive nor a negative relation between extraversion and attitude towards computers.

Similarly, more recent studies and current work have looked at the relationship between Eysenck's personality dimensions of extraversion and neuroticism, and attitudes and/or anxiety towards computer/Internet. Moreover, some of these studies have examined the relationship between the two Eysenckian dimensions and computer/Internet use.

The relations between extraversion and attitude/anxiety towards computers/Internet or computer use and the relation between neuroticism and attitude/anxiety or use seem to appear inconsistent among most recent findings. In general, the patterns are similar to those emerging from previous literature, as reviewed and discussed within my PhD thesis.

The hypothesis, that there is a negative correlation between neuroticism and computer-related attitudes and a positive correlation between neuroticism and computer anxiety, was supported by Anthony, Clark and Anderson (2000). The similar hypothesis, that there is a negative correlation between neuroticism and computer/Internet use, was supported by Swickert, Hittner, Harris and Herring (2000), and Hamburger and Ben-Artzi (2000). However, Hamburger and Ben-Artzi (2003), Hills and Argyle (2003) and Wilson (2000) found no association between neuroticism and computer/Internet use.

The hypothesis, that there is a negative correlation between extraversion and computer-related attitudes is not consistent with Anthony et al's (2000) results, which found no relation between extraversion and computer attitude or anxiety. Similarly, Hill and Argyle (2003) and Wilson (2000) found no relationship between extraversion and computer/Internet use. Moreover, Swickert et al (2002) found only a marginal relation. On the other hand, Hamburger and Ben-Artzi (2000, 2003) found a positive relation between extraversion and the use of the computer or the Internet.

It seems that further studies are needed to clarify the conditions under which the hypotheses linking personality and computer attitudes or use hold good and the conditions under which they do not hold good.

A representative and indicative sample of some recent empirical studies will be reported in some detail below. The criterion of selection was their contextual similarity to the research presented and discussed within my PhD thesis. The intention was that these studies illustrate some of the main issues currently arising in the area. Some emphasis was given to the details of the measures used.

Anthony, Clarke and Anderson (2000) investigated technophobia and its relationship with selected personality types and computer experience. The subjects were 176 South African undergraduate students enrolled in first-year psychology and computing courses.

Rosen and Weil's (1992) Measuring Technophobia Instruments (MTI) were used to measure technophobia. The MTI consists of the CARS-C (assessing computer anxiety and nervousness), CTS-C (assessing positive and negative cognitions while using computers), the GATCS-C (measuring attitudes towards using computers and computerised technology), Demographic Data, and Technology Experience Questionnaire (assessing experience across 11 areas of computer use by rating each area on a four-point frequent scale).

Personality types were measured by the NEO-FFI (Form S) (Costa and McCrae, 1992). This is the shortened version of the original NEO Personality Inventory (NEO-PI-R). The questionnaire consists of 60 statements that reflect five personality dimensions: extroversion, neuroticism, openness, agreeableness, and conscientiousness. Participants respond by using a five-point Likert scale (strongly disagree to strongly agree).

Data analysis revealed that half of the participants experienced no technophobia. This could be explained by their levels of prior computer experience. Indeed, subjects reported high levels of experience with computers and computerised technology.

Moreover, Neuroticism, as measured by NEO-FFI, was found to be correlated to technophobia, as measured by the MTI. In particular, Neuroticism correlated highly and significantly with computer anxiety ($r=0.28$), and even more highly with negative computer cognitions and thoughts ($r=-0.41$). Openness was found to correlate with computer anxiety ($r=-0.25$) but not with cognitions while using a computer.

Swickert, Hittner, Harris, and Herring (2002) aimed to determine the relationship between computer/Internet use and personality types. The subjects were 206 students from computer science, political science, psychology, and sociology classes at a medium-sized public liberal arts college in the southeastern United States.

Again, the NEO-FFI (Costa and McCrae, 1992) was used to assess extroversion, neuroticism, openness, agreeableness, and conscientiousness. Computer/Internet use was assessed by the Computer Use Survey (CUS). The survey asks subjects to record the amount of time (hours/minutes) in an average week that they use computers for: search and do research, visit bulletin boards, visit chat rooms, create/update websites, play games, use email, use instant messaging, visit multi-user dungeons, and access information as a form of entertainment (e.g. read newspaper, listen to music, etc).

Personality variables were found to marginally relate to email use, accessing information, instant messaging, and playing games. In particular, neuroticism seemed to be most consistently related to the various types of computer activities, in that, individuals who score low in neuroticism are more likely to engage in the computer activities.

Moreover, agreeableness was found to correlate with email use and accessing information, and extraversion as well as conscientiousness were found to correlate with instant messaging and playing games.

In a similar study, Hamburger and Ben-Artzi (2000) examined the relationships between computer (Internet services) use and extraversion, and computer use and neuroticism. The subjects were 72 students who described themselves as Internet users and were enrolled in courses at the Psychology and Mathematics departments of an Israeli University. An important aspect of this study, compared to others, was the inclusion of the 'loneliness' variable, which may be considered as an index of combination and expression of several personality traits and an indicator contributing to the sense of well-being.

Extraversion and neuroticism were measured by the Eysenck's Personality Inventory (EPI) (Eysenck and Eysenck, 1975). The questionnaire consists of 48 yes-no questions (a 24-item extraversion scale and 24-item neuroticism scale) that reflect the two personality dimensions. Eysenck and Eysenck (1975) reported high correlations between the extraversion and neuroticism scales and related sub-scales of other personality measures, such as the Minnesota Multiphasic Personality Inventory (MMPI) and the California Psychological Inventory (CPI).

Computer/Internet use was assessed by the Internet –Services Scale. This measure asks subjects to rate the frequency of Computer/Internet use on a seven-point scale (from 1 "not at all" to 7 "a lot") for the following 12 most popular Internet services: seeking information related to work, seeking information related to studies, seeking general information, discussion groups, games downloading, software downloading, chat, shopping, news, sex web-sites, random surfing, and people address seeking.

An exploratory factor analysis of computer uses (or Internet services) revealed three factors: social services (chat, discussion groups, and people-address seeking), information services (work-related information and studies-related information), and leisure services (sex web-sites and random surfing). Correlations between extraversion and computer use, as well as between neuroticism and computer use, indicated that extraversion was positively related to use of leisure services, whereas neuroticism was negatively related to information services.

In a further study, Hamburger and Ben-Artzi (2003) examined the relationships among the variables of Internet use, feelings of loneliness, extroversion, and neuroticism. The subjects were 85 individuals who described themselves as Internet users and most of them were students

enrolled in courses at the Psychology departments of an Israeli University and an Israeli College.

As with the previous study, Internet Use was assessed by the Internet-Services Scale (Hamburger and Ben-Artzi, 2000). As before, Internet services were classified in three factors: social services, information services, and leisure services. As before, extraversion and neuroticism were measured by the Eysenck's Personality Inventory (EPI) (Eysenck and Eysenck, 1975). Loneliness was measured by the UCLA Loneliness Scale (Russell et al, 1980). This consists of 20 positive and negative statements that reflect an individual's social relations. Participants rate on a four-point scale [from "not at all" (1) to "very much" (4)] the extent to which the statements describe them.

Correlations between the personality variables and the use of the Internet services revealed that, for all subjects, extraversion was positively related to information services ($r=0.24$) and leisure services ($r=0.24$). Loneliness was found to be negatively related to leisure services ($r=-0.14$). However, neuroticism was not found to relate to any of the Internet services.

Hills and Argyle (2003) investigated the relationships among intensity of Internet use, Internet service preferences, and several individual differences in personality and overall well-being. The subjects were 220 residents of Oxfordshire, mainly professionals. As before, an important aspect of this study, compared to others, was the inclusion of the 'loneliness' variable, which may be considered as an index of combination and expression of several personality traits and an indicator contributing to the sense of well-being.

Extraversion, neuroticism, and psychoticism were measured by the respective sub-scales of the short-scale form of the revised Eysenck's Personality Questionnaire (Eysenck, Eysenck, and Barrett, 1985). This measure was accompanied by Rosenberg's Self-esteem Scale (SES) (Rosenberg, 1989), and the Satisfaction with Life Scale (SWLS) (Diener, Emmons, Larson, and Griffin, 1985). Loneliness was measured by an abridged version of the Social and Emotional Loneliness Scale for Adults (SELSA) (DiTommaso and Spinner, 1993). This is a 37-item questionnaire with three sub-scales measuring romantic, family, and social loneliness. The abridged version (12 items) included the four strongest items from each of the sub-scales. Subjects were also asked to indicate their level of overall happiness on a numerical scale ranging from one to ten.

Computer/Internet use was assessed by the Internet Use Scale (IUS). This was a list of 16 different Internet services, including email. Subjects were asked to rate the frequency of Computer/Internet use of each service on a five-point Likert scale ("never" to "a lot"). Subjects were also asked to indicate where they used the Internet (at home, at college/university, at work, or elsewhere), and to record the amount of time each week that they use computers and the Internet.

Correlations between the frequency of use of individual services and the personality and other variables (i.e. extraversion, neuroticism, psychoticism, self-esteem, loneliness, happiness, etc) indicated only a few significant associations. None was strong and the most frequent relationship was with psychoticism. Also, there were only a few significant partial correlations. Those were weak and scattered and did not form any recognisable pattern.

These results provide no support to previously reported findings that Computer/Internet use does relate to extraversion (e.g. Hamburger and Ben-Artzi, 2000; Hamburger and Ben Artzi, 2003), and neuroticism (e.g. Swickert et al, 2002; Hamburger and Ben-Artzi, 2000). However, results seem to confirm previously reported findings that Internet use does not relate either to extraversion (e.g. Swickert et al, 2002) or neuroticism (e.g. Hamburger and Ben-Artzi, 2003).

Computer/Internet use was very common (83%) among the subjects participating in this study. On average, each subject used the Internet for approximately 8 hours each week. Sending emails to friends was the most frequently used Internet service used almost by all subjects. It was closely followed by seeking general information, work emails, and getting information for work. Chat groups and online gaming were found to be the least frequent activities. On average, each subject made use of 9 different services.

Wilson (2000) conducted a correlational study of the relationship between individual characteristics and use of computer-mediated communication systems looked at the effects of personality type (in particular, extroversion-introversion, intuitive-sensing, thinking-feeling, and judging-perceiving) on computer-mediated communication system usage in a team project situation. Thus, personality typology was measured by these four dimensions of Jungian personality measures (e.g. Carey, 1991; Keirsey and Bates, 1984). Computer usage was measured by the number of messages sent and number of words sent in messages during the team project.

Correlations and multiple regression analyses suggested that sensing-thinking subjects showed significantly greater computer-mediated communication usage, sending almost twice as many email messages and twice as much message content, compared to intuitive-feeling subjects. However, none of the remaining personality variables was found to be significantly related to computer-mediated communication usage.

Despite the uncertainty of some of the findings outlined above, several authors take a positive view of future developments. They argue that results on the link between personality and computing/Internet are important because they suggest that personality may determine, to an extent, computer and Internet use as well attitudes and anxiety towards computers (e.g. Anthony et al, 2000). Amichai-Hamburger (2002) suggested that further research should be conducted to look at those computer/Internet interfaces and uses that produce positive effects for a personality type but negative for others. These authors also recommend more research to be conducted both on the relationship between Computer/Internet use and the Big Five (including extraversion and neuroticism), and on the relationship between Computer/Internet use and personality types in addition to the ones previously discussed.

Thus, Amichai-Hamburger (2002) asserts that "web providers would be better served to research and target certain personality types and develop services accordingly. For example, 'Chat' is unlikely to have the same effect on an introverted personality as on an extroverted person". The author also suggests that certain personality types or patterns may be particularly relevant and have a particularly strong impact on computer or Internet use. A concise summary of some of these types is presented below. Amichai-Hamburger suggests they would provide a useful focus for future research.

1) Locus of control (Rotter, 1966, 1982). People with an internal locus of control believe in their own ability to control their life events whereas people with external locus of control believe that life events are controlled by external factors, such as powerful others, luck or chance. This may be relevant to the thought and control of time when on the Internet.

2) The Need for closure (e.g. Kruglanski and Freund, 1983). People who have high need for closure try to avoid uncertainties, get locked in conceptions, reach conclusions quickly, and tend to ignore contradicting information. On the other hand, people with a low need for closure are predisposed to consider many alternative hypotheses and to test as many implications of their hypotheses as possible. This personality characteristic may be related to the liking and actual use of hyperlinks within a website. People with low need for closure may like and use them whereas those with a high need for closure may not.

3) Innovators (e.g. Kirton, 1994). This personality dimension differentiates between people according to the way they approach change, in that, innovators are nonconformist, creative, and feel comfortable in an unstructured situation, whereas conformists need roles and norms and seek stability and order. This may be relevant to web design and use, and related, for example, to the question whether a web site should remain constant or change frequently.

4) Attachment (e.g. Hazan and Shaver, 1987). Secure style of attachment entails confidence in the availability of attachment figure(s) in times of need, and comfort with closeness and interdependence. The avoidant style entails insecurity concerning others' intentions, preference for emotional distance, and fear of intimacy. The anxious-ambivalent style also entails insecurity concerning others' responses, but is additionally associated with a strong desire for intimacy, passionate love, and high fear of rejection. These distinctions may be relevant to the liking and use of the shallow relationships that are common on the Internet, as well as to the type and duration of these encounters.

5) Risk taking (e.g. Levenson, 1990). This personality dimension differentiates people according to the extent they are ready to take an action that involves a significant degree of risk. This may be relevant to the use of new Computer/Internet services that have a potential or an image of involving some degree of risk or insecurity, such as banking activities or sometimes shopping.

6) Personality structure of profile of interests (e.g. Holland, 1985). Six personality types can be defined according to the activities they strongly prefer to get involved to: the realistic type, the investigative type, the artistic type, the social type, the enterprising type, and the conventional type. This may be relevant to the question why different computer users like and use different Computer/Internet services.

Finally, Amichai-Hamburger (2002) suggested that further research should be conducted on the personality characteristics and profiles of people who do not use computers and/or Internet services. Understanding these people's profiles as well as their attitudes towards computers and the Internet may be of paramount significance not only for the designing of websites but also for improving literacy, performance, and satisfaction in computing.

References

- Anthony, L.M., Clarke, M.C. and Anderson S.J. (2000). Technophobia and personality subtypes in a sample of South African university students. *Computers in Human Behavior*, 16 (2000) 31-44.
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84, 191-215.
- Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist*, 37, 122-147.
- Bandura, A. (1986). *Social foundations of thought and action: a social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.
- Brosnan, M.J. (1999). Modeling technophobia: A case for word processing. *Computers in Human Behavior*, 15 (1999) 105-121.
- Brosnan, M. and Lee, W. (1998). A cross-cultural comparison of gender differences in computer attitudes and anxieties: The United Kingdom and Hong Kong. *Computers in Human Behavior*, 14 (4), 559-577.
- Chua, S.L., Chen, D.T. and Wong, A.F.L. (1999). Computer anxiety and its correlates: a meta-analysis. *Computers in Human Behavior*, 15 (1999) 609-623.
- Compeau D.R. and Higgins, C.A. (1995). Computer self-efficacy: Development of a measure and initial test. *MIS Quarterly*, 19 (2), 189-211.
- Costa, P.T., and McCrae, R.R. (1992). *NEO PI-R: professional manual. Revised NEO Personality Inventory (NEO PI-R) and NEO Five Factor Inventory (NEO-FFI)*. Odessa, FL: Psychological Assessment Resources (PAR).
- Davis, F. (1986). A Technology Acceptance Model for empirically testing new end-user information systems: Theory and results. Doctoral Dissertation, Sloan School of Management, MIT.
- Davis, F. (1993). User acceptance of information technology: System characteristics, user perceptions and behavioral impacts. *International Journal of Man-Machine Studies*, 38, 475-487.
- Davis, F.D., Bagozzi, R.P., and Warsaw, P.R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science*, 35 (8), 983-1003.
- Diener, E., Emmons, R.A., Larson, R.J., and Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment*, 49, 71-75.
- DiTommaso, E., and Spinner, B. (1993). The development and initial validation of the social and emotional loneliness scale for adults (SELSA). *Personality and Individual Differences*, 14, 127-134.
- Eysenck, H.J., and Eysenck, S.E.G. (1975). *Manual: Eysenck Personality Inventory*. San Diego, CA: Educational and Industrial Testing Service.
- Eysenck, S.B.G., Eysenck, H.J., and Barrett, P. (1985). A revised version of the psychoticism scale. *Personality and Individual Differences*, 6, 21-29.

- Gardner, D.G., Dukes, R.L., and Discenza, R. (1993). Computer use, self-confidence, and attitudes: A causal analysis. *Computers in Human Behaviour*, 9, 427-440.
- Gressard, C.P., and Loyd, B.H. (1986). Validation studies of a new computer attitude scale. *Association of Educational Data Systems Journal*, 18, 295-301.
- Hamburger, Y.A., and Ben-Artzi, E. (2000). The relationship between extraversion and neuroticism and the different uses of the Internet. *Computers in Human Behavior*, 16 (2000) 441-449.
- Hamburger, Y.A. (2002). Internet and personality. *Computers in Human Behavior*, 18 (2002) 1-10.
- Hamburger, Y.A. and Ben-Artzi, E. (2003). Loneliness and Internet use. *Computers in Human Behavior*, 19 (2003) 71-80.
- Hasan, B. (2003). The influence of specific computer experiences on computer self-efficacy beliefs. *Computers in Human Behavior*, 19 (2003) 443-450.
- Hazan, C., and Shaver, P. (1987). Romantic love conceptualized as an attachment process. *Journal of Personality and Social Psychology*, 52, 511-524.
- Heinssen, R.K., Jr., Glass, C.R., and Knight, L.A. (1987). Assessing computer anxiety: Development and validation of the Computer Anxiety Rating Scale. *Computers in Human Behavior*, 3, 49-59.
- Hemby, K.V. (1998). Self-directedness in non-traditional college students: A behavioral factor in computer anxiety? *Computers in Human Behavior*, 14 (2), 303-319.
- Hills, P. and Argyle, M. (2003). Uses of the Internet and their relationships with individual differences in personality. *Computers in Human Behavior*, 19 (2003) 59-70.
- Holland, J.L. (1985). *Making vocational choices*. Englewood Cliffs, NJ: Prentice-Hall.
- Knowles, M.S. (1984). *Andragogy in action: Applying modern principles of adult learning*. San Francisco: Jossey-Bass.
- Kirton, M.J. (1994). *Adapters and innovators: Styles of creativity and problem solving*. London: Routledge.
- Kruglanski, A.W., and Freund, T. (1983). The freezing and unfreezing of lay-inferences: Effects on impression primacy, ethnic stereotyping, and numerical anchoring. *Journal of Experimental Social Psychology*, 19, 448-468.
- Levenson, M.R. (1990). Risk taking and personality. *Journal of Personality and Social Psychology*, 58, 1073-1080.
- Liaw, S. (2002). An Internet survey for perceptions of computers and the World Wide Web: relationship, prediction, and difference. *Computers in Human Behavior*, 18 (2002) 17-35.
- Loyd, B.H. and Gressard C.P. (1984). Reliability and factorial validity of computer attitude scales. *Educational and Psychological Measurement*, 44, 501-505.
- Loyd, B.H. and Gressard, C.P. (1986). Validation studies of a new computer attitude scale. *Association of Educational Data Systems Journal*, 18, 295-301.

- McIlroy, D., Bunting, B., Tierney, K., and Gordon, M. (2001). The relation of gender and background experience to self-reported computing anxieties and cognitions. *Computers in Human Behavior*, 17 (2001) 21-33.
- Mikkelsen, A., Ogaard, T., Lindoe, P.H. and Olsen, O.E. (2002). Job characteristics and computer anxiety in the production industry. *Computers in Human Behavior*, 18 (2002) 223-239.
- Oddi, L.F. (1986). Development and validation of an instrument to identify self-directed continuing learners. *Adult Education Quarterly*, 36, 97-107.
- Oetting, E.R. (1983). *Oetting's Computer Anxiety Scale*. Fort Collins, CO: Rocky Mountain Behavioral Science Institute.
- Popovich, P., Hyde, K., Zakrajsek, T., and Blumer, C. (1987). The development of the attitudes toward computer usage scale. *Educational and Psychological Measurement*, 47, 261-269.
- Potosky, D. and Bobko, P. (1998). The Computer Understanding and Experience Scale: A self-report measure of computer experience. *Computers in Human Behavior*, 14 (2), 337-348.
- Rosen, L.D., and Weil, M.M. (1992). Measuring Technophobia. *A manual for the administration and scoring of the Computer Anxiety Rating Scale, the Computer Thoughts Survey and the General Attitude Toward Computers Scale*. Chapman University, USA. Available: lrosen@dhvx20.csudh.edu.
- Rosenberg, M. (1989). *Society and the adolescent self-image*. Middletown CT: Wesleyan University Press.
- Rotter, J.B. (1966). Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs: General and Applied*, 80 (1), 1-28 (Whole No. 609).
- Rotter, J.B. (1982). *The development and application of social learning theory*. New York: Praeger.
- Russell, D., Peplau, L.A., and Cutrona, C.E. (1980). The revised UCLA Loneliness Scale: concurrent and discriminant validity evidence. *Journal of Personality and Social Psychology*, 39, 472-480.
- Schumacher, P. and Morahan-Martin, J. (2001). Gender, Internet and computer attitudes and experiences. *Computers in Human Behavior*, 17 (2001) 95-110.
- Selwyn, N. (2000). Researching computers and education – glimpses of the wider picture. *Computers and Education*, 34 (2), 93-101.
- Shelley, J.O. (1998). Factors that affect the adoption and use of electronic mail by K-12 foreign language educators. *Computers in Human Behavior*, 14 (2) 269-285.
- Simonson, M.R., Maurer, M., and Torardi-Montag, M. (1987). Development of a standardized test of computer literacy and a computer anxiety index. *Journal of Educational Computing Research*, 3, 231-247.
- Smith, B., Caputi, P., Crittenden, R., Jayasuriya, R. and Rawstorne, P. (1999). A review of the construct of computer experience. *Computers in Human Behavior*, 15 (1999) 227-242.

- Smith, B., Caputi, P. and Rawstorne, P. (2000). Differentiating computer experience and attitudes toward computers: An empirical investigation. *Computers in Human Behavior* 16 (2000) 59-81.
- Swickert, R.J., Hittner, J.B., Harris, J.L., and Herring, J.A. (2002). Relationships among Internet use, personality, and social support. *Computers in Human Behavior*, 18 (2002) 437-451.
- Todman, J., and Dick, G. (1994). Primary children and teacher's attitudes to computers. *Computers and Education*, 20, 199-203.
- Torkzadeh, G., and Van Dyke, T.P. (2001). Development and validation of an Internet self-efficacy scale. *Behaviour and Information Technology*, 20 (4), 275-280.
- Torkzadeh, G. and Van Dyke T.P. (2002). Effects of training on Internet self-efficacy and computer user attitudes. *Computers in Human Behavior*, 18 (2002) 479-494.
- Venkatesh, V. (1999). Creation of favorable user perceptions: exploring the role of intrinsic motivation. *MIS Quarterly*, 23 (2), 239-260.
- Wilson, E.V. (2000). Student characteristics and computer-mediated communication. *Computers and Education*, 34 (2000) 67-76.

Overview of the literature

The diagram below provides a schematic overview of results within the literature on the relationships of computer attitudes to stress, performance, prior computing experience and four personality variables. For the sake of clarity the diagram has been split in two. Figure 1a illustrates the effects of attitude on stress and performance, and figure 1b shows relationships of prior experience and personality to other variables. Details of these relationships and inconsistencies in the findings are shown in table 1.

Note that in the figures a continuous-line arrow indicates a fairly strong relationship whereas a dotted-line arrow indicates a weak relationship. A continuous line with 'bullet-type' endings indicates that although an association between the two variables linked has been established, there is no consensus about the direction of the association. A dotted line with 'bullet-type' endings indicates that although the relationship between the two variables linked has been investigated, no association was found. Finally, the absence of a linking line between any two variables indicates that the relationship between these variables has not been examined within the literature.

A central point of interest in the literature has been computer attitude and its relationship to prior experience. There has been less work on the relationship of these variables to actual performance and experienced stress: similarly there is comparatively little research on effects of personality, apart from locus of control. Despite the fact that no consistent schema or model can be reached with certainty, due to contradictory, ambiguous, scarce or non-existent findings in the literature, a vague thread running through the literature may be detected; the reviewed research suggests that attitude appears to be influenced mainly by prior experience and, to a lesser extent, by all personality variables reviewed except A typology (which has not been examined in relation to attitude). Stress seems to be influenced by prior experience, locus of control and, to a lesser extent, A typology (neuroticism and extraversion were not examined in relation to stress); and performance appears to be determined by attitude/anxiety and, to a lesser extent, by all personality variables reviewed but neuroticism (which was not examined in relation to performance). The possibility of performance being influenced by prior experience was not examined within the literature.

Figure 1a is intended to illustrate the relationships between attitude and stress, and between attitude and performance. The change of attitude (from "Attitude" to "Attitude2"), as a result of some type of computer course, is also indicated. In particular, attitude (in the main low computer anxiety) appears to have a positive effect on computer performance. Attitude in general, however, seems to have no effect on computer stress. Finally, there is no consensus about the attitude change or direction of change as a result of some type of computer course.

Figure 1b is intended to illustrate the relationships of prior experience to the variables of attitude, stress and performance, as well as the relationships between each of the personality variables involved and each of the variables of attitude, stress and performance. In particular, prior experience seems to have a positive effect on attitude with some exceptions; however, there is no agreement on whether there is any effect of prior experience on stress nor about the direction of a possible effect (as indicated by the continuous line with 'bullet-type' endings). Note that the relationship between prior experience and performance has not been examined within the literature (as indicated by the absence of any linking line between the two variables).

Considering personality variables, internal locus of control appears to have an effect on attitude (with no universal agreement about the effect being positive or negative), seems to be negatively related to stress, and positively but weakly related to performance. A typology seems to influence stress and performance positively and weakly, and have a negative impact on subjective difficulty. Extraversion in the literature appears to have a negative or no effect on

attitude – only some negative effect on performance has been suggested. Neuroticism seems to affect computer attitude, but there is disagreement about the direction of the influence except in relation to the specific construct of computer anxiety which is almost always found to be positively associated with neuroticism. Finally, personality, and in particular internal locus of control, has been suggested to have a positive or no impact on prior computer experience (not shown in figures).

The table is followed by a detailed narrative account describing the variables examined and associations found in the literature – including theoretical and statistical commentary.

Overview of the Literature

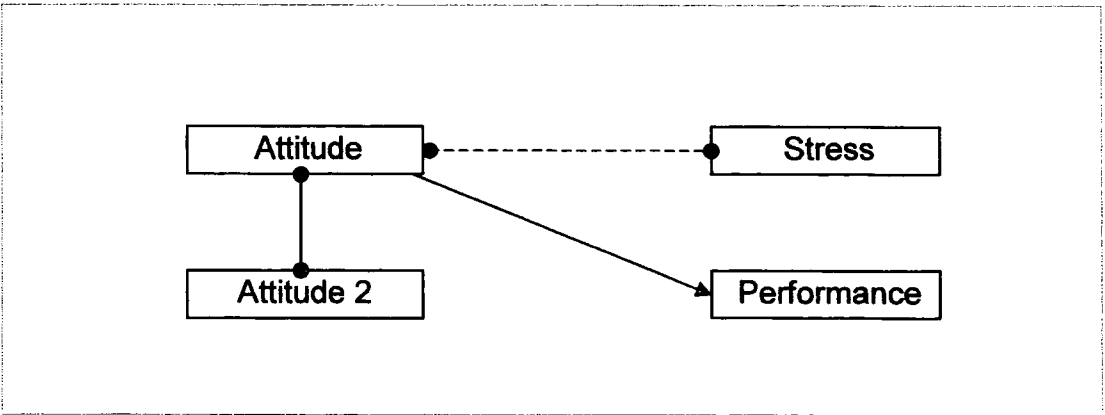


Fig 1a: Relationships with attitude

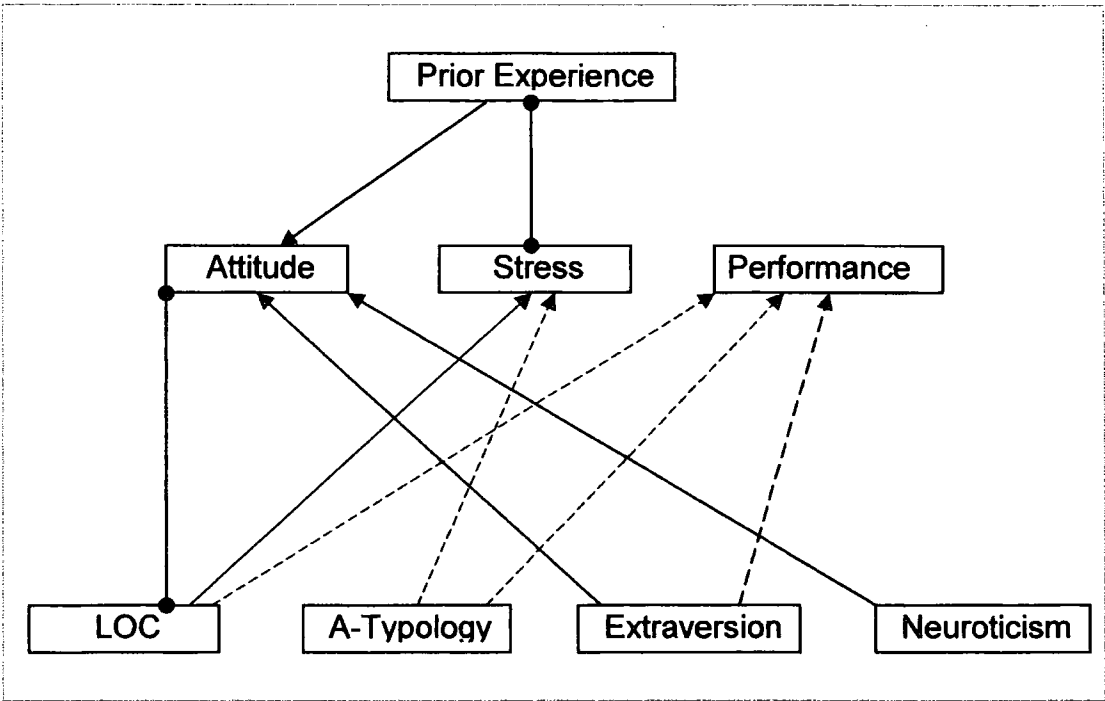


Fig 1b: Relationships with prior experience and personality

Table 1: Overview of the Literature

	Attitude (including computer anxiety)	Stress	Performance (and subjective difficulty)
Attitude (including computer anxiety)	<u>Attitude 2</u> <ul style="list-style-type: none"> • Computer attitude improves and anxiety decreases • Attitude does not improve and anxiety does not decrease • Computer anxiety does not decrease and at times increases 	<ul style="list-style-type: none"> • Scarce evidence within literature. • Suggestion that computer stress is relatively independent of computer attitude and anxiety 	<ul style="list-style-type: none"> • Little research within literature • Computer anxiety is a good predictor of computer achievement • Computer achievement is more a function of computer anxiety than of computer experience
Prior Experience	<ul style="list-style-type: none"> • Positive relation between experience and attitude (with minor exceptions) • Negative relation between experience and anxiety (with exceptions) 	<ul style="list-style-type: none"> • Positive relation (especially in relation to training and instruction) • Negative relation (in relation to task difficulty and interest in the task) • No effect 	Not examined
Locus of Control	<ul style="list-style-type: none"> • Positive effect of internal LoC on attitude • Positive effect of external LoC on attitude • Locus of control had a less or more strong effect on anxiety/attitude than experience 	<ul style="list-style-type: none"> • Negative relation between internal LoC and stress (weaker than the relation between LoC and attitude) • Relation can sometimes depend upon the type of stress encountered 	Performance only: <ul style="list-style-type: none"> • No effect • Weak positive effect of internal LoC on performance
A-Typology	Not examined	Scarce evidence within literature. Generally, a positive relation suggested	A Typology related positively and weakly to performance (<i>and negatively to subjective difficult</i>).
Extraversion	<ul style="list-style-type: none"> • No effect • Extraversion negatively related to attitude, and positively to anxiety 	Not examined	<ul style="list-style-type: none"> • Scarce evidence within literature • Some suggestion that there is a negative relation
Neuroticism	<ul style="list-style-type: none"> • A definite positive relation between neuroticism and anxiety • Negative relation between neuroticism and attitude • No relation between neuroticism and attitude (excluding anxiety) 	Not examined	Not examined

Narrative review of the literature

First, the pattern of computer attitude and anxiety change as a consequence of completing some type of computer course (and as emerging from the literature) will be concisely indicated.

Second, the relation between attitude and stress, and attitude and performance will be briefly described.

Third, the association between prior computer experience and the variables of computer attitude, stress and performance will be briefly described.

Last, the association between each of the personality variables (Locus of control, A Typology, Neuroticism and Extraversion) and the variables of computer attitude, stress and performance will be presented.

1. Change of attitude

There are several studies that have measured changes in computer attitude (and related anxiety) levels as a consequence of completing some type of computer course.

Most studies on the impact of computer experience on computer attitude and anxiety through computer training have been attempts to measure the computer attitude and anxiety of the same group of individuals before and after a number of training sessions. Then studies try to assess the direction and the magnitude of the change of attitude and anxiety scores from before to after computer interaction, i.e. whether computer experience through training makes attitude and anxiety improve or deteriorate and to what extent. Similarly to the studies on the effect of prior computer experience on attitude and related anxiety (as seen in next section), there is evidence that undertaking any of a range of various types of computer training leads to improved computer attitude and decreased computer anxiety. Results have suggested that experience through training may induce more favourable attitudes and reduce or eliminate the fears that users may have (e.g. Reed and Palumbo, 1992; Rosenbluth and Reed, 1992; Galagan, 1983).

In spite of the substantial number of pre-test/post-test studies reporting a positive relation between computer attitude and computer experience, and a negative relation between computer anxiety and computer experience (e.g. Harrington et al, 1990; Czaja and Sharit, 1998; Brown and Coney, 1994; Gressard and Loyd, 1985; Igbaria and Chakrabarti, 1990), this result is by no means universal. For example, Rosen et al (1987) found that computer anxiety did not decrease with computer experience, and at times actually increased. In contrast, while both McInerney et al (1994) and Leso and Peck (1992) found that computer anxiety generally decreases with experience, they also found that high levels of computer anxiety persist in some individuals despite training. Similarly, Koslowsky et al (1987) found no improvement in students' computer attitude, and, in a more recent study, Torkzadeh and Dyke (2002) found no significant difference between pre-training and post-training computer attitudes. Woodrow (1994) found neither improvement of attitudes nor reduction of anxiety, and Temple and Gavillet (1990) found no decrease in older novice users' computer anxiety as a function of training. Moreover, Chu and Spires (1991) showed that a computer course may be an appropriate method to reduce computer anxiety, but only for some cognitive styles. Finally, while Lambert (1991) found a relation between computer anxiety and computer experience, those subjects with initially low levels of computer anxiety experienced increased levels of state anxiety when faced with a novel task. Thus, the relation between computer attitude/anxiety and computer experience gained by some type of computer course seems to be more complex than a general improvement on attitude and reduction in anxiety with experience.

2. Attitude in association with stress and performance

Attitude and stress

Hudiburg (1989a) showed that computer-related stress was relatively independent of attitudes towards computer technology. Moreover, his stress scale was found not to be related either to a measure of computer attitude or a measure of computer anxiety. Hudiburg (1989a) obtained these results by conducting correlational analyses.

Attitude and performance

There is little research and direct findings within the literature on the relation between computer attitude and performance. By conducting multiple regressions, Marcoulides (1988) showed that computer anxiety is a good predictor of computer achievement. He also found computer achievement to be more a function of computer anxiety than of computer experience. In a correlational study, Heinssen et al (1987) looked at computer task performance and found that higher levels of computer anxiety were related to longer time spent to complete a task.

3. Prior experience in association with attitude, stress and performance

Prior experience and attitude

The vast majority of relevant studies have found and reported a positive relation between amount of prior computer experience and computer attitude, and a negative relation between prior experience and computer anxiety (e.g. Levine et al, 1997, 1998; Levin and Gordon, 1989; Koohang and Byrd, 1987; Loyd, Loyd, and Gressard, 1987; Todman and Monaghan, 1994; Maurer, 1994; Rosen and Weil, 1995; Mahmood and Medewitz, 1989; Jay, 1985; Ray and Minch, 1990; Marcoulides, 1988; Heinssen et al, 1987; Morrow et al, 1986).

More recent studies have also found a positive relation between prior experience and attitudes. For example, Liaw (2002), Schumacher and Morahan-Martin (2001), and McIlroy et al (2001) showed the positive relation between prior experience and attitudes, whereas Hasan (2003) showed the positive relation between prior experience and self-efficacy.

Similarly, more recent studies found computer anxiety to be inversely related to prior experience (e.g. Chua et al, 1999; McIlroy et al, 2001; Shelley, 1998), and Brosnan (1999) found that lower levels of computer anxiety were associated with higher levels of computer usage.

However, these findings are not universal. For example, Mahmood and Medewitz (1989) found that as people become computer literate, they form positive opinions towards IT applications but do not significantly change their attitudes and values towards IT itself. Among the main implications of this study is that computer anxiety or computer-phobia, generated by negative attitudes and values towards IT and its applications, is a complex matter that cannot be resolved merely by computer literacy.

Moreover, Marcoulides (1988) clearly showed that while those subjects with greater computing experience tended to have less computer anxiety, however some anxiety existed regardless of experience level.

In most cases, the theoretical model was tested by Analysis of Variance (ANOVA), Correlations, Multiple Regression Analysis, and, in a small number of cases, Structural Equation Analysis (using the LISREL program).

Prior experience and stress

The effects of prior computer experience on stress have been studied by a very limited number of researchers. Their results are varied and sometimes contradictory. For example, Hudiburg (1989, 1990) and Balance and Balance (1996) suggested that people who have more prior computer experience tend to experience more computer-related stress. However, Dolan and Tziner's (1988) results indicated that while those with previous experience reported higher levels of experienced stress associated with contextual aspects such as training and instruction, those without prior experience reported greater problems with work content aspects such as task difficulty and interest in the task. Dolan and Tziner (1988) also found that while subjects with experience showed greater stress with regard to issues such as training and information, subjects without experience reported significantly higher levels of stress with regard to aspects such as work autonomy, health and safety, and career path. On the other hand, Kumashiro et al (1989) and Turner (1980) suggested that there is no relation between the amount of computer use and psychological strain.

At the statistical level, while in most cases researchers used correlations and multiple regressions, Kumashiro et al also used factor analysis.

Prior experience and performance

There are no findings within the literature on the relation between prior computer experience and performance.

4. Personality in association with attitude stress, and performance

4.1. Locus of control in association with attitude, stress and performance

Locus of control and attitude

In considering the majority of the general research on locus of control, it would be reasonable to speculate that internals will have confidence in their own ability to master and control computers, just as they have been confident and able in controlling and mastering other challenges. Hence, it would be expected that, compared to externals, internals will show a lower level of computer anxiety and more favourable attitudes towards computers

In particular, Morrow et al (1986) found that locus of control was significantly related to computer anxiety with higher externality accompanied by higher levels of anxiety. [However, in Morrow et al's work, computer experience explained more of the variance in computer anxiety than did locus of control, a finding which implied that computer anxiety may be more a function of prior experience (an easier modifiable situation) than locus of control (a more deeply entrenched personality trait)].

Furthermore, Coovert and Goldstein (1980) found that internals and externals have different attitudes towards computers, with internals having overall a more positive and less negative attitude towards computers than externals. In particular, it was found that those with positive attitudes towards computers showed higher internality than those with negative attitudes towards computers; and those with positive attitudes towards computers felt that 'powerful others' and 'chance' (dimensions of externality) were less controlling in their lives than those with negative attitudes towards computers. In support of this, Wesley et al (1985) found that internals have more positive attitudes towards computers than externals.

However, and contrary to the previous results, Woodrow (1990) found a more positive attitude towards computers among externals rather than internals. In particular, those who felt that academic success depends upon effort were negative in all their attitudes towards computers. And those who believed that luck influences academic achievement had generally positive attitudes towards computers. Also, among internals, those who felt that effort mainly

determined academic success showed the most negative attitudes towards computers. On the other hand, only the belief that achievement success is ability driven generated the attitudes of computer confidence and liking but it did not reduce computer anxiety. Finally, Woodrow generally found locus of control to account for more variation in computer attitudes than computer experience.

Most researchers within the area obtained their results by conducting correlational analyses, Analyses of Variance (ANOVAs), and Multiple Regressions.

Locus of control and prior experience

Some interesting findings on the relationship between locus of control and computer experience will be concisely reported at this stage.

Wesley et al (1985) showed that internals were more likely to have previous computer experience than externals; subjects with internal locus of control were more likely to engage in computer related activities than subjects with external locus of control; and 'internal' individuals are more motivated to become computer literate than those whose locus of control is external. Wesley et al suggested that locus of control is an important and major factor in motivating one to gain computer experience, or, in other words, to become computer literate. Wesley et al also reported that internals showed greater knowledge of computer hardware, software, programming, applications, and society issues. In support of this, Horak and Horak (1982), and Horak and Slobodzian (1980) suggested that internals were more likely to take the initiative to gain experience and become knowledgeable about computers as well as to persist in their efforts (even in the face of problems) until their goals were attained.

However, and contrary to previous results, Woodrow (1990) found no significant difference in previous computer experience between the internally-oriented and externally-oriented subjects.

Locus of control and stress

Locus of control has generally been identified and frequently used as an internal moderator of response to stress (Cooper and Sutherland, 1988; Payne, 1988). Studies of psychological adjustment and coping abilities have shown internals to be less anxious and better able to deal with frustration. The 'external', in contrast, appears "less psychologically healthy" (Peck and Whitlow, 1975). In addition, a number of studies have suggested that a person's perceived control over a situation is an advantage in managing environmental stress agents (Greer et al, 1970).

Believed control in the personal determination of events is viewed as a factor in the expectation of coping with a stressful situation; and so less threat is experienced by the 'internal' compared to the 'external' oriented individual, who tends to believe in luck or fate (Cooper and Sutherland, 1988).

However, although internals' perception of control may help reduce stress in most situations, internals may display more anxiety and even higher stress levels than externals, in situations perceived to be not within their control (Cooper and Sutherland, 1988). Thus, the relationship between locus of control and stress responses can greatly depend upon the type of stress encountered.

Krause and Stryker (1984) suggested "that extreme externals are vulnerable to stress because they are less likely to bother taking positive actions, whilst the high internals are paralyzed by their own guilt since they believe that failure to cope is their own fault".

In his review, Payne (1988) points out that Syrotnick and D'Arcy (1982), in studying 854 employed males, reported that externals used more social support under pressure than internals did, but came to the conclusion that locus of control does not have extensive moderator effects on stress(or)-(di)stress relationships. However, in studying 171 nurses, Parkes (1984) found that the internals reported more adaptive coping responses, and this was particularly true when the situations were cognitively appraised as potentially controllable and important to the subject.

Subsequently, an internal locus of control orientation has been found to be a major characteristic of the 'hardy personality' types (Kobasa, 1988), who are able to maintain good health despite high stress levels.

In considering the majority of the general relevant research, it would be reasonable to speculate that internal locus of control personality types will have confidence in their own ability to master and control computers, just as they have been confident and able in controlling and mastering other challenges. Hence, it would be expected that, compared to externals, internals will show lower levels of stress in a threatening situation, such as in using or in anticipation of using computers.

This argument may also provide some justification for the inclusion of locus of control as a possible correlate of computer stress, anxiety, and (after considering the relation between attitude and anxiety) attitudes. If internal locus of control personality type individuals are believed to be better equipped personality-wise to handle threats, they could also be expected to be less anxious or stressed in a threatening situation, such as in using or in anticipation of using computers.

Most researchers within the area obtained their results by conducting correlational analyses, Analyses of Variance (ANOVAs), and Multiple Regressions.

Locus of control and performance

Research on the relation between locus of control and performance shows internals to be frequently associated with academic success and greater motivation to achieve (Cooper, Cooper and Eater, 1988). Also, internals tend to seek information and engage the problem, whereas externals are more likely to react with helplessness (Cooper and Sutherland, 1988).

Moreover, there is a lot of research indicating that internals show more motivation, achievement, and better performance than the externals. For example, DeSanctis (1982) reported that internals have greater motivation, make more effort, utilise more resources, and spend more time in making decisions than externals; whereas Rotter (1966) pointed out that internals "are likely to be more overt in striving for achievement". Broedling (1975) found that internal locus of control employees were more motivated to work, and perform better than externals; and Lefcourt (1972) and Phares (1976) discovered that internals engage in greater information search activity. In addition, Zmud (1980) reported that internals request more information than externals, leading DeSanctis (1982) to hypothesise and (after research) confirm that internals tended to use a computerised decision support system more than externals.

Research on locus of control and computing suggested that internals were more likely to take the initiative to become knowledgeable about computers and to persist in their efforts, (even in the face of problems), until their goals were attained. In addition, as their knowledge about computers increased, their attitudes towards computers also became more positive and their performance improved too; this, in turn, led to further gains of computer experience and knowledge (e.g. Horak and Horak, 1982; Horak and Slobodzian, 1980).

Furthermore, findings from studies among student computer novices, and on causal - attributional beliefs (or locus of control), supported the prediction that students whose locus of control was internal gained more from 'low-structure' situations than students whose locus of control was external. This was shown by their subsequent performance in computing tasks (e.g. Horak and Horak, 1982; Horak and Slobodzian, 1980).

In his 1985 study, Wesley et al, by using Rotter's locus of control scale (Rotter, 1966), found that pre-service teachers with internal locus of control were more likely to engage in computer related activities than their peers with external locus of control. These findings suggest that 'internal' individuals have more positive attitudes towards computers, better performance in computing and are more motivated to become computer literate, than those whose locus of control is external.

In addition, Wesley et al (1985) found that internally - oriented subjects scored significantly higher on the cognitive part of the Minnesota Computer Literacy and Awareness Assessment (MCLAA) (Anderson et al, 1979) than did externally - oriented subjects.

Wesley et al, among other studies, suggested that both computer attitudes and perceptions of locus of control are important and major factors in motivating one to gain computer knowledge and experience, or, in other words, to become computer literate.

Griswold (1982) argued that locus of control may be a very important factor in the development of computer awareness and related attitudes. In particular, he suggested that internally - oriented individuals should be less intimidated by computers than externally - oriented individuals, more able to cope with the demands of learning to use a computer, and more competent in developing efficient programming skills. In his study among education majors, Griswold (1983) also found that locus of control explained more of the variation in computer awareness than did age, gender, number of mathematics courses and arithmetic skill.

Furthermore on the relationship between locus of control and computer performance, four empirical studies have attempted to identify whether locus of control is related to computer programming performance (Chin and Zecker, 1985; Nowaczyk, 1983; Wilson, Mundy-Castle, and Cutts, 1989; Wesley, Krockover, and Hicks, 1985). Chin and Zecker (1985) found that locus of control was a significant predictor of programming success, with internals being more successful than externals. Also, Wesley, Krockover, and Hicks (1985) reported that internals showed greater knowledge of computer hardware, software, programming, applications, and society issues.

However, Nowaczyk (1983) found that locus of control was not a significant variable in its ability to predict programming success; he noted though that the majority of his subjects tested as being internals and he did not have a sufficiently large range of scores.

On the other hand, Wilson, Mundy-Castle, and Cutts (1989) found mixed results in that for 15 black Zimbabwean females, LOGO scores were negatively related to internal locus of control; for 38 white Zimbabwean females, unrelated; and for 16 black and 36 white Zimbabwean males positively related to internal locus of control.

It seems that generally computer programming performance is positively related to internal locus of control. However, the different instruments used, the varying results, and the large difference in sample size prevents one from making any definite conclusions.

Most researchers within the area obtained their results by conducting Analyses of Variance (ANOVA's), correlational analyses, and Multiple Regressions.

4.2. Type A in association with attitude, stress and performance

Type A and attitude

The relationship between A typology and computer attitudes has not been looked at by any researcher in the field. There is certainly a prospect for research into this area – studies that directly examine the effects of Type A-B personality dimensions (or behaviour pattern) on attitudes towards computers.

Type A and stress

A Typology is the personality construct or behaviour pattern that has frequently been linked to stress. Type A has also been linked to time urgency, impatience, anger, depression and hostility; it was also claimed to significantly increase a person's chances of suffering coronary heart disease (Rosenman, Friedman, and Straus, 1964).

Hart et al (1987) suggested that Type As may exhibit more stress than Type Bs when performing various sets of computer tasks.

Van Dijkhuizen and Reiche (1980) showed that Type As exhibited more psychological complaints and higher diastolic blood pressure, whereas Orpen (1982) found that Type A middle-managers experienced greater stress and strain at work.

Caplan and Jones (1975) found that the correlation between changes in subjective workload and changes in anxiety and the relationship between changes in anxiety and heart rate (due to the temporary shutdown of the main computer in a university) was higher for Type A than Type B persons. And Keenan and McBain (1979), in a study of middle-managers, found that the correlation between A typology and role ambiguity (regarded as a source of stress at work) was significantly higher than the correlation between Type B and role ambiguity.

Generally, although the extent to which Type A moderates the relationship between stressors and strain has not been determined within the relevant (scarce) literature, the weight of the evidence appears to be that, for Type A persons, the relationship between reported stressor and strain is stronger; for Type Bs, this relationship is either much weaker or close to zero (Cooper and Payne, 1988).

Type A, performance, and subjective difficulty

Type A behaviour pattern had originally been described as consisting of some combination of extreme competitiveness and achievement striving, a strong sense of time urgency, job involvement, ever-increasing expectations of personal productivity and impatience – characteristics relatively absent in the Type B behaviour pattern (Chesney and Rosenman, 1983; Cooper et al, 1988). In addition, Van Dijkhuizen and Reiche (1980) showed that Type As reported more quantitative workload, more responsibility for people, and more use of skills. These behaviour patterns may influence how people perceive, perform, and evaluate tasks: Type As may adopt different personal performance criteria, exert different levels of effort, and report different subjective experiences than Type Bs.

Also, Type As tend to work faster than Type Bs even when no time limits are imposed (Damos and Bloem, 1985), and when forced to slow their pace not only report boredom but also show performance decrements (Glass, 1977). Moreover, Type As tend to compete with (sometimes unrealistically) high self-imposed performance standards. For example, Damos and Bloem (1985) found that Type As were less satisfied with their performance than Type Bs although they performed better.

Hart et al (1987) found that Type As performance scores were higher than Type Bs in four practice and four experimental sets of computer tasks of different level of difficulty. And Type As performance scores improved more than Type Bs between these practice and experimental sets of computer tasks. In general, Hart et al's study suggests that the distinction between Type A and Type B behavioural characteristics can provide significant and useful information about a potential source of individual differences in computer performance.

An additional important point, regarding subjective (perceived) difficulty experienced when completing computer tasks, is that Type A subjects evaluated their performance more stringently, and they appeared to be less sensitive to the effort they exerted to achieve their (higher) performance scores; their physical and mental effort ratings were lower and they reported similar levels of fatigue, even though they appeared to have been working harder than Type Bs, according to the higher number of function-key actuations that they made.

Results described here were mainly obtained by conducting Analyses of Variance (ANOVAs), Correlations, and Interviews.

4.3. Extraversion in association with attitude, stress and performance

Extraversion and attitude

Research had originally suggested that a positive attitude towards computers may reflect a preference for solitary activities and an avoidance of social interaction (Alspaugh, 1972), while extraversion is clearly characterised by sociability, a preference for group activities and an avoidance of solitary activities (Eysenck and Eysenck, 1975). These relations suggest a negative correlation between extraversion scores and computer-related attitudes. This is consistent with Bozeman's (1978) findings which reported some degree of relation between extraversion and apprehension of computer technology, and with Katz and Offir's (1991) findings. On the other hand, Egg and Meschke (1989), Sigurdsson (1991), Katz and Francis (1995), Francis (1995), and Katz (1993) found neither a positive nor a negative relation between extraversion and attitude towards computers.

Subsequently, Francis, Katz and Evans (1996) found a significant negative correlation between extraversion scores and attitude towards computers, and thus introverts were found to have a more positive attitude towards computers than extraverts. This result lends support to the hypothesis that a more positive attitude towards computers may be positively related to a more general tendency to prefer solitary activity and to avoid social activities. This conclusion was also supported by Katz and Offir (1991), although not by Sigurdsson (1991), Katz (1993), Katz and Francis (1995) and Francis (1995).

In a more recent study (Anthony, Clark and Anderson, 2000), the hypothesis, that there is a negative correlation between extraversion and computer-related attitudes was not consistent with the results, which found no relation between extraversion and computer attitude or anxiety.

Most studies examining the effects of extraversion on computer attitudes used correlation and regression analyses.

Extraversion and stress

It appears that there is no relevant research examining the effects of extraversion on computer stress – there is certainly a prospect for research into this area.

Extraversion and performance

There is very little relevant research on extraversion and computer performance. However, introverted students had greater examination success than extraverts in the physical sciences (Wankowski, 1973). In addition, introverted students were less dissatisfied and achieved better performance on a simulated non-stimulating work task than extraverts (Kim, 1980). Also, extraverted workers found it more difficult than introverts to maintain work performance over time (Furnham, 1992, 1995) or driving performance over a four-hour period (Fagerstrom and Lisper, 1977).

It might be speculated that the quiet, reserved, tidy-minded, well ordered and well organised personality characteristics of the introverts might positively affect their computer performance, since computers may be perceived as compatible with these characteristics.

Four empirical studies investigated whether extraversion contributes to predicting general computer programming achievement. In particular, Kagan and Esqerra (1984) found that extraversion was negatively correlated with achievement on FORTRAN exams. However, Kagan and Douthat (1985) indicated that ability to master BASIC was unrelated to extraversion. Chin and Zecker (1985) found no significant correlation between extraversion and success in computer programming, but their study was limited to 32 college student volunteers. Last, Newsted (1975) sent a survey to college students and assessed introversion/extraversion via one question. He did not find the dimension to be significant in predicting success.

In short, only one of the four studies found extraversion related to computer programming. However, the large difference in sample size, the varying results, and the different instruments in some cases used, prevent one from making any definite or reasonable conclusions regarding the relation between extraversion and computer programming achievement.

All studies examining the effects of extraversion on performance used correlational analyses and regressions.

4.4. Neuroticism in association with attitude, stress and performance

Neuroticism and attitude

Research suggests that a positive attitude towards computers is inversely related to computer anxiety (e.g. Gressard and Loyd, 1986), while specific anxieties tend to be related to trait anxiety and to the underlying personality dimension of neuroticism (Francis, 1993). These relations suggest a negative correlation between neuroticism and computer-related attitudes. Although this hypothesis is supported by the findings of Sigurdsson (1991) Katz and Offir (1991) and Katz (1993), it is not however supported by Egg and Meschke (1989), Katz and Francis (1995) or Francis (1995) except in relation to the specific construct of computer anxiety.

Subsequently, Francis, Katz and Evans (1996) found no significant correlation between neuroticism scores and attitude towards computers. This result does not support the hypothesis that a more positive attitude towards computers is inversely related to neuroticism. This finding was also supported by Katz and Francis (1995) and Francis (1995), while Sigurdsson (1991), Katz and Offir (1991) and Katz (1993) found a significant negative correlation between neuroticism and computer-related attitudes.

In a more recent study, Anthony, Clark and Anderson (2000) supported the hypothesis, that there is a negative correlation between neuroticism and computer-related attitudes and a positive correlation between neuroticism and computer anxiety.

Studies examining the relation between neuroticism and computer attitude used correlations and multiple regressions.

Neuroticism and stress

An individual with a high level of neuroticism could be expected to be more vulnerable not only to specific types of anxiety, such as computer anxiety, but also to experienced stress before and during interaction with computers.

However, it appears that there is virtually no relevant research on the effects of neuroticism on computer stress.

Neuroticism and performance

After considering the general literature on neuroticism, it may be that individuals who score low on neuroticism have better performance on computing tasks. However, there is no relevant research on the effects of neuroticism on computer performance.

References

References are provided either at the 'References' section of the thesis (pp 212-235) or at the end of Appendix Thirteen (pp 278-281).

Overview of the present research

Three diagrams are given below to provide a concise overview of the relationships found between the different variables in the present study.

In particular, figure 1 provides a general description of main findings as well as a framework for further thinking and discussion. Note that a continuous-line arrow indicates a fairly strong relationship whereas a dotted-line arrow indicates a weak relationship. Figure 1 shows that the central point of attention within the present study was computer attitude and its relationships to three 'behaviour' variables (stress, performance and subjective difficulty). Thus, attitude appears to directly affect the 'behaviour' variables of computer stress, performance and subjective difficulty. In turn, attitude seems to be directly and strongly affected by prior computer experience, and, to a lesser extent, by the personality of a computer user. In addition, there is a direct and weaker effect of prior experience on 'behaviour' variables and also a direct, albeit weak, effect of personality typology. Although causality is difficult to establish, it seems reasonable to suggest that in the main prior computing experience indirectly determines computer stress and performance via computer attitude – in particular computer confidence. A similar argument is applied to personality variables. Direct influence of experience and personality typology on the 'behaviour' variables does contribute to the model but to a much lesser extent. The possibility of prior experience being influenced by personality typology has not been examined within the present study, but it is logically plausible, so a link is shown in figure 1 by a distinct dotted line linking personality and prior experience.

Figure 2 is a detail of Figure 1, intended to illustrate the relationships between attitude and each of the 'behaviour' variables, and also the relationships between each of the particular personality variables examined and attitude. The change of attitude from "Attitude" to "Attitude2" as a result of a computer course is also indicated. Specifically, attitude seems to have a strong effect on stress and subjective difficulty and a rather weak effect on performance. Attitude, in turn, seems to be influenced by the personality variables of locus of control, A typology, neuroticism and, to a lesser extent, extraversion. Finally, attitude does change (and becomes less favourable) as a result of a computer course.

Figure 3 is a second detail of Figure 1, illustrating the 'direct' relationship between prior computer experience and each of the 'behaviour' variables (stress, performance and subjective difficulty). In particular, prior computing experience seems to influence stress, have some effect on subjective difficulty and no impact on performance (as indicated by a dotted line with 'diamond' endings). Relationships between each of the personality variables involved and the 'behaviour' variables are also indicated. All combinations were examined, but for clarity, only those cases where an association was found are shown. Personality variables tend to have weak or no 'direct' effects on stress, performance and subjective difficulty. Exceptions are the relationships between locus of control and stress, and between neuroticism and stress, where the impact of personality is stronger.

Further details of the relationships shown in the diagrams are spelled out in the following two tables where the direction of relationships and some further details have been provided. Table 1a gives details of the relationships of prior experience and the three personality variables to attitude, while table 1b shows effects of prior experience, personality and attitude on stress, performance and subjective difficulty

The tables are followed by a detailed narrative account describing the variables examined and associations found in the present research, including theoretical and statistical commentary. The findings are set in the context of the published literature.

Present Research

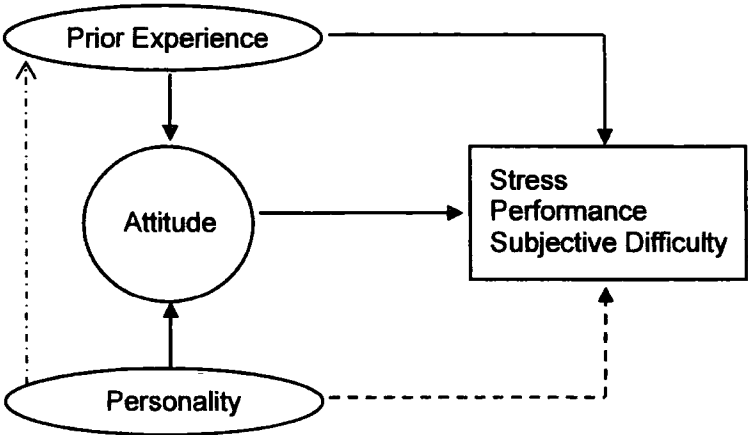


Fig 1 General scheme relating personality and prior experience to performance variables

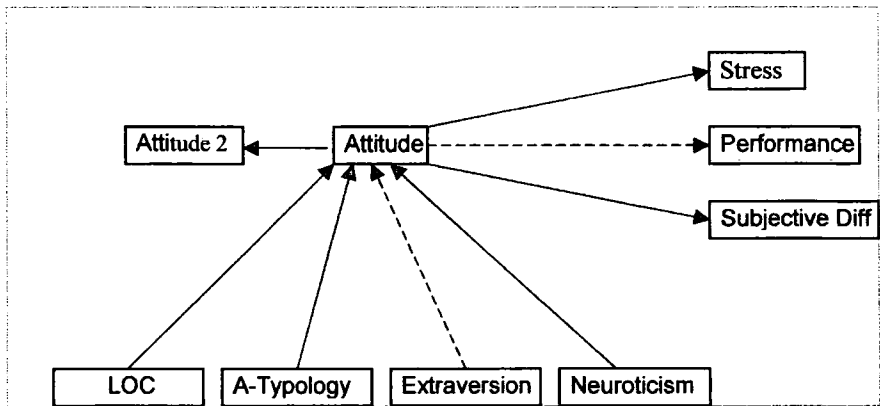


Fig 2 Detail of personality and attitude plus attitude and performance variables

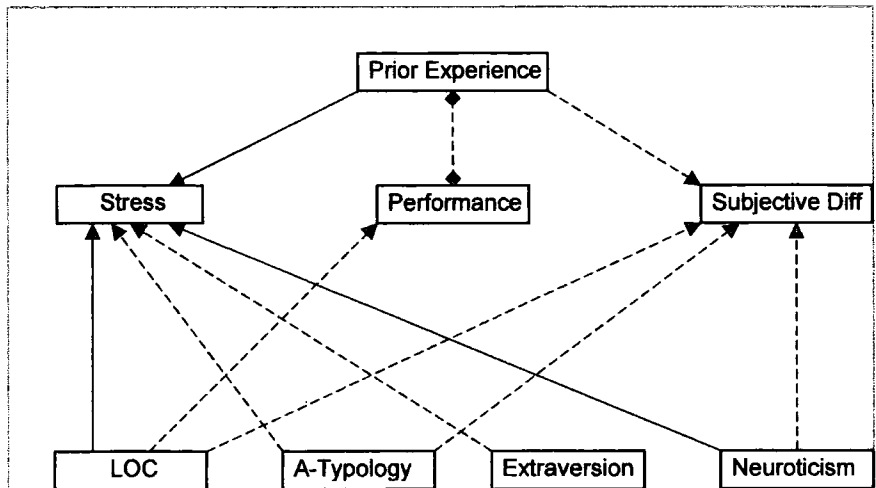


Fig 3 Detail of prior experience, personality and performance variables

Present research: Table 1a

	Attitude (including computer anxiety)
Prior Experience	Positive relation between experience and attitude only for high experience users Negative relation between experience and computer anxiety only for high experience users.
Locus of Control	Positive effect of internal LoC on attitude LoC had a less strong positive effect on attitude than experience
A-Typology	Positive relation between A-Typology and attitude Negative relation between A-Typology and computer anxiety
Extraversion	Extraversion negatively related to computer anxiety No effect of extraversion on overall attitude (i.e. confidence or liking)
Neuroticism	Positive relation between neuroticism and computer anxiety Negative relation between neuroticism and general attitude

Present research: Table 1b

	Stress	Performance	Subjective Diff
Attitude	Negative relation between attitude and stress (Positive relation between computer anxiety and stress)	Rather weak positive relation. (Weak negative relation with computer anxiety)	Rather strong positive relation. (Negative relation with computer anxiety)
Prior Experience	Negative relation (higher levels of experience associated with lower levels of all types of stress)	No effect	Some positive effect of experience due to the groups of medium and high levels of experience
Locus of Control	Negative relation between internal LoC and stress (as strong as the relation between LoC and attitude) (higher levels of internality associated with lower levels of all types of stress)	No effect of LoC (Paulhus'). Fairly weak positive effect of internal LoC (Levenson's)	Some positive effect of internal LoC (Levenson's and Paulhus')
A-Typology	Slightly negative relation (the 'higher' the A Typology the lower the levels of stress)	No effect	Weak positive effect of Type A
Extraversion	Negative relation between extraversion and 'stress before' computer sessions only	No effect	No relation
Neuroticism	Relatively strong relation between neuroticism and all types of stress	No effect	Rather weak negative effect

Narrative review of the present research

First, the relation between attitude and stress, attitude and performance, and attitude and subjective difficulty will be briefly described. Change of stress will also be presented in this section.

Second, the association between prior computer experience and computer attitude will be presented.

Third, the association between each of the personality variables (Locus of control, A Typology, Neuroticism and Extraversion) and computer attitude will be described.

Fourth, the pattern of computer attitude and anxiety change as a consequence of completing some type of computer course (and as emerging from my own research) will be concisely indicated.

Fifth, the association between prior computer experience and the variables of computer stress, performance and subjective difficulty will be briefly described.

Last, the association between each of the personality variables (Locus of control, A Typology, Neuroticism and Extraversion) and the variables of computer stress, performance and subjective difficulty will be presented.

1. Attitude in association with stress, performance and subjective difficulty

Attitude

This was measured by a) the Computer Attitude Scale (CAS) (Loyd and Gressard, 1984), providing for scores on three subscales (computer anxiety, confidence and liking), and b) the Durham Computer Attitude Scale (DCAS) (Crook, 1989), measuring, in the main, the degree of liking for using computers.

The present results indicate that subjects' attitudes towards computers, as measured by CAS and DCAS, were neutral to (slightly) positive at start. By the end of the academic year, subjects' attitudes towards computers, although less favourable than the beginning of the academic year, were still neutral to slightly positive. An exception was computer liking, as measured by the respective CAS subscale, where subjects' responses were on average slightly negative at the end of the academic year.

Stress and change of stress

The data were explored with repeated measures two-tailed tests. These were performed on stress for each week separately, to assess whether the scores on stress after computer interaction were significantly different than the scores on stress before computer interaction.

This analysis of the change of the stress scores (from before to after computer sessions) on Cox's Stress and Arousal Checklist (SACL) indicated that computer interaction was stress inducing but only transiently, in the first out of four weeks of data collection, and only for users with high prior experience. Stress scores **after** computer interaction increased significantly for the first week of the practicals, had a tendency to increase for the second week (although this result was not statistically significant), and remained approximately the same for the third and fourth week.

According to the present results, a computer session **can** change (increase) levels of stress; and computer operation **can** be per se stressful. However, the increase of stress from before to after

computer interaction is experienced only by users with high prior experience and is rather transient (within the present research, there was such an increase only for the first week's computer session).

However, the frequency results, derived from the 'subjective ratings' (CPTOT), indicated that overall a large proportion of all subjects appeared to feel stressed (an average of 35%), frustrated (34%), and out of control (39%). In contrast to SACL (which was used to indicate change of stress), the subjective ratings provide an indication of computer stress (and related feelings) as experienced in absolute terms.

[Subjective ratings were used to provide additional data, relevant to experienced stress, with the intention of tapping issues such as helplessness, control, and in addition the possibility of frustration and anger or aggression].

Attitude and stress

Results derived from correlations indicated that all three variables of computer-related stress ['stress before' and 'stress after' computer sessions, both measured by SACL, and subjective ratings taken after sessions (CPTOT)] were significantly and negatively correlated with all measures of attitudes towards computers (computer anxiety, confidence and liking, as indicated by CAS, and general computer attitude, as measured by DCAS).

The relationship between computer attitudes and computer-related stress was further explored on the basis of the results derived from multiple regressions, where stress variables (dependent) were regressed upon attitude variables (independent). Computer confidence was found to be the strong predictor variable in determining subjective ratings, and the fairly strong and only variable in predicting 'stress after' computer sessions. It is only where the dependent variable is 'stress before' (computer sessions) that computer anxiety and not computer confidence accounts for most of the variance in the outcome. It makes sense that computer anxiety significantly contributes to stress prior to computer sessions, since this can be interpreted as related to anticipatory (to a computer session) anxiety. However, although computer anxiety is the key predictor of 'stress before', it does not add anything to the variance of any other stress variable.

General attitude, as measured by DCAS, appears to be a good predictor of subjective ratings. And computer liking does not appear to account for the variance in any of the stress variables.

When an 'experience dummy variable' was added to the attitude (independent) variables, it was found that experience contributed minimally to the model and thus had a small effect in predicting only stress before computer sessions.

[Within this context, computer experience was expressed as a dummy variable that contrasts the 'high experience' group with all others. (The 'high' group was the only group that significantly differed from all others on initial computer attitude as well as on change of attitude as a result of a computing course)].

In view of the previous correlation and multiple regression findings, it would appear that there is a close relationship between attitudes and stress. Although correlations should not be interpreted as cause-and-effect relationships, an interpretation could be that more positive and anxiety-free attitudes towards computers produce lower levels of stress, measured immediately before and after a session with the computer. It may also be reasonable to suggest that the experience of lower computer stress may, in turn, enhance and increase the positivism of computer attitudes.

These results contradict Hudiburg's (1989a) findings which showed that computer-related stress was relatively independent of attitudes towards computer technology. In support of this, among other evidence, Hudiburg's stress scale was found not to be related either to a measure of computer attitude or a measure of computer anxiety.

Attitude and performance

Results derived from correlational analysis indicated three significant, positive but small correlations between computer attitudes (CAS: computer anxiety, confidence, and liking), and computer performance; and there was a slightly larger significant correlation between computer attitude, as measured by DCAS, and computer performance.

The relationship between computer attitudes and computer performance was further explored on the basis of the results derived from multiple regressions, where performance (dependent variable) was regressed upon attitude variables (independent). Only computer confidence was found to be a weak variable in predicting performance. When an 'experience dummy variable' was added to the attitude (independent) variables, it was found that experience added nothing to the variance of performance. It was concluded that, in this context, performance was not a function of experience.

In view of the correlation and regression findings, it would generally appear that there is a rather weak relationship between attitudes and performance, in that a more positive, confident and anxiety-free attitude is slightly associated to better actual computer performance.

This result confirms Marcoulides' (1988) findings which showed that computer anxiety is a good predictor of computer achievement, and computer achievement is more a function of computer anxiety than of computer experience. The present finding also confirms Heinssen et al's (1987) result which reported that higher levels of computer anxiety were related to longer time spent to complete a computer task.

Attitude and subjective difficulty

Results derived from correlational analysis indicated three significant and positive correlations between computer attitudes (CAS: computer anxiety, confidence, and liking), and subjective difficulty experienced when dealing with computer tasks during actual computer operation; computer confidence gives the largest correlation and liking the smallest. There was an also significant and positive correlation between computer attitude, as measured by DCAS, and subjective difficulty.

The relationship between computer attitudes and subjective difficulty was further explored on the basis of the results derived from multiple regressions, where subjective difficulty (dependent variable) was regressed upon attitude variables (independent). Computer confidence was found to be the only and key variable in predicting subjective difficulty. When the 'experience dummy variable' was added to the attitude (independent) variables, it was found that experience added nothing to the variance of subjective difficulty. It was concluded that, in this context, subjective difficulty was not a function of experience.

In view of the correlation and regression findings, it would generally appear that there is a rather strong relationship between attitudes and subjective difficulty, in that a more positive, confident and anxiety-free attitude is associated to less subjective difficulty experienced when completing various computer tasks.

2. Prior experience in association with attitude

Prior experience

Responses to Question 1 (Part II) of the Durham Computer Attitude Scale (DCAS) (Crook, 1989) were considered. This question regards Computer Use, and requires subjects to indicate what sort of

things they use computers for and to rank order eight alternative activities (see Appendix 2). In an attempt to distinguish applications which involve perhaps a basic understanding or a more 'formal' use of computers from those more general, 'fun' or everyday applications, the eight alternative uses and users were categorised into four groups:

- 1: No Experience - Naive Users
- 2: Only Computer Games Players
- 3: Medium Users: Communications, Word Processing, and Instructional / Educational Programs.
- 4: High Users: Program Development, Statistical Analysis, Control, and Other.

Prior experience and attitude

The present results indicate that subjects with greater initial computer experience did have more positive initial (i.e. at the beginning of the academic year) attitudes, than those subjects with relatively less experience. This was true for computer anxiety, confidence, and liking, as measured by the Computer Attitude Scale (CAS), and general attitude / computer liking, as measured by the Durham Computer Attitude Scale (DCAS). However, the only experience group that had significantly different (more favourable) initial attitudes than any other group was the one of the high experience users. It appears that only a lot of prior computer experience can positively affect computer attitude.

These results were obtained by employing Analyses of Variance (ANOVAs), and Bonferroni and Duncan tests.

These findings seem to confirm the vast majority of relevant studies that found a positive relation between amount of prior computer experience and computer attitude, and a negative relation between prior experience and computer anxiety (e.g. Levine et al, 1997, 1998; Levin and Gordon, 1989; Koohang and Byrd, 1987; Loyd, Loyd, and Gressard, 1987; Todman and Monaghan, 1994; Maurer, 1994; Rosen and Weil, 1995; Mahmood and Medewitz, 1989; Jay, 1985; Ray and Minch, 1990; Marcoulides, 1988; Heinssen et al, 1987; Morrow et al, 1986).

However, the present results seem to partially negate Mahmood and Medewitz's (1989) study, which found that as people become computer literate, they form positive opinions towards IT applications but do not significantly change their attitudes and values towards IT itself.

3. Personality in association with attitude

3.1. Locus of control in association with attitude

Locus of control

Two locus of control instruments were used: a) Levenson's locus of control (1974) scale clearly reflects three recognised views of locus of control (Internal, Powerful Others, and Luck), as derived from the popular, well-established and standardised Rotter's (1966) Internal-External (I-E) scale. Levenson has improved the I-E scale mainly by differentiating between externals who attribute control to 'chance' and externals who attribute control to 'powerful others'. b) Paulus' Spheres of Control (SOC) inventory (1989) is a more recent established and standardised locus of control measure, which appears to be complementary to Rotter's and Levenson's scales. It reflects three views of locus of control (Personal, Interpersonal, and Socio-political) by subdividing Rotter's internality rather than externality. Thus, Levenson's scale appears to distinguish dimensions, whereas Paulus' scale appears to distinguish domains. It is noteworthy here that, in general, the

locus of control construct entails a family of measures that may include different dimensions, domains, or both. Often, different dimensions or domains do not particularly correlate; and different locus of control scales can give different results (Furnham, 1987).

Locus of control and computer attitude

For Levenson's locus of control subscales, there was only one significant (but rather small) correlation between computer anxiety and chance. For Paulhus' locus of control subscales however, there were four clearly significant and positive correlations between two attitude dimensions (computer anxiety and computer confidence) and two Paulhus' subscales (personal and interpersonal control). Neither of the locus of control scales shows much relation to the 'computer liking' attitude subscale; and only Paulhus' 'personal control' subscale relates to general attitude, as measured by the DCAS.

In view of these findings, it would generally appear that there is a relationship between attitudes and locus of control, in that an individual with an internal locus of control is more likely to have more confidence, experience less anxiety, and show a more positive attitude towards computer technology.

This result seems to confirm Coovert and Goldstein's (1980) as well as Wesley et al's (1985) findings that internals have overall a more positive and less negative attitude towards computers than externals. The present result also confirmed Morrow et al's findings (1986) that higher externality of locus of control is significantly related to higher computer anxiety.

The present findings also agreed with the more general literature on the locus of control construct suggesting that internals would be less prone to computer anxiety and negative computer attitudes because of their general confidence in their own ability to control and master challenges. However, the present results seemed to contradict Woodrow's (1990) findings which suggested that externals rather than internals have more positive attitudes towards computers.

Similarly to Coovert and Goldstein's (1980) findings, a possible hypothesis that those subjects with negative attitudes towards computers may view the computer as a powerful other was not upheld. No correlation between Levenson's 'powerful others' dimension and any of the attitude variables was significant. The reason that those with negative attitude towards computers did not tend to view the computer as a 'powerful other' may be explained by research performed by Orcutt and Anderson (1977). These authors, while using computers to study social interaction, found that subjects did not tend to personify the computer as much as they tended to dehumanise (human) others.

Locus of control and experience on computer attitude

Some interesting findings on the relative effect of locus of control and computer experience on computer attitude will be concisely reported at this stage.

Thus, stepwise regressions were conducted to see whether locus of control or computer experience carries more weight in predicting computer attitude. Within this context, computer experience was expressed as a dummy variable that contrasts the 'high experience' group with all others. (The 'high' group was the only group that significantly differed from all others on initial computer attitude as well as on change of attitude as a result of a computing course).

Thus, attitude variables (dependent) were regressed upon locus of control with 'experience' variables (independent). It was clearly indicated that in all cases experience had a much stronger effect on computer attitudes than locus of control.

This result is consistent with Morrow et al's (1986) work but contradicts Woodrow's (1990) findings.

3.2. A Typology in association with attitude

A Typology

The Occupational Stress Indicator (OSI; Cooper et al, 1988) was used. The (sub)instrument used in this study, consists of three subscales, one of which is 'Style of behaviour'. This subscale measures the behavioural component of the Type A, i.e. what individuals actually do. The underlying issues that run through the items are speed abruptness of behaviour, impatience, haste, etc.

'Broad view of Type A' can be considered as a quick summary assessment representing the total Type A subscale score.

A Typology and computer attitude

There was a significant correlation between 'The Broad view of Type A' and computer anxiety, and an also significant correlation between 'Broad view' and computer confidence. There was also a smaller but significant correlation between 'Broad view' and general computer attitude, as measured by DCAS. No significant correlation was found between 'Broad view' and computer liking or between 'Style of behaviour' and any of the attitude variables.

In view of these findings, it would generally appear that there is at least some relationship between attitudes and A Typology, in that an individual with higher Type A pattern of behaviour is more likely to have more confidence, experience less anxiety, and show a more positive attitude towards computers.

There is no way to compare the present result to findings within the literature, since there is no research on the relation between A Typology and computer attitude.

3.3. Extraversion in association with attitude

Extraversion and computer attitude

The only significant correlation found was between extraversion and computer anxiety. No association was found between extraversion and any of the remaining attitude variables.

This result suggested that a person's computer anxiety is closely related to their levels of extraversion: In particular, the higher the levels of extraversion, the lower the levels of computer anxiety (and thus the more positive the computer attitude).

This result seems to be inconsistent with Bozeman's (1978) findings which reported some degree of relation between extraversion and apprehension of computer technology.

Since computer anxiety may be seen as a component of computer attitude, the present findings seem to contradict research that suggests a negative correlation between extraversion and computer-related attitudes (e.g. Katz and Offir, 1991; Francis, Katz and Evans, 1996). Moreover, the present result seems to negate the results of studies that found neither a positive nor a negative relation between extraversion and computer-related attitudes (e.g. Egg and Meschke, 1989; Sigurdsson, 1991; Katz and Francis, 1995; Francis, 1995; Katz, 1993).

Also, the present findings appears to negate research which argues that a positive attitude towards computers may reflect a preference for solitary activities and an avoidance of social interaction

(Alspaugh, 1972), while extraversion is clearly characterised by sociability, a preference for group activities and an avoidance of solitary activities (Eysenck and Eysenck, 1975). These relations suggest a negative correlation between extraversion scores and computer-related attitudes.

Although this result negates much of the relevant literature, it may be interpreted as indirectly confirming some of the general literature on extraversion. For example, previous findings by Wankowski (1973) suggested that extraverted students tended to choose practical or people-oriented courses, whereas introverted students preferred more theoretical subjects. In this context, computing may be seen as a practical rather than a people-oriented activity.

Finally, the present findings seem to negate the results of a more recent study (Anthony, Clark and Anderson, 2000) which found no relation between extraversion and computer attitude or anxiety.

3.4. Neuroticism in association with attitude

Neuroticism and computer attitude

There were two significant correlations between neuroticism and the attitude dimensions of anxiety and confidence. There was also a rather small but significant correlation between neuroticism and general computer attitude, as measured by the DCAS.

In view of these findings, it would generally appear that there is a relationship between neuroticism and computer attitudes, in that an unstable (or neurotic) individual is likely to have less confidence, experience more anxiety, and show a less positive (or more negative) attitude towards computers.

The present findings confirm research that found a negative correlation between neuroticism and computer-related attitudes (e.g. Sigurdsson, 1991; Katz and Offir, 1991; Katz, 1993); they are not, however, supported by Egg and Meschke (1989), Katz and Francis (1995), or Francis (1995) except in relation to the specific construct of computer anxiety.

Moreover, the present results negate Francis et al's (1996) findings, where the absence of a significant correlation between neuroticism scores and attitude towards computers did not support the hypothesis that a more positive attitude towards computers is inversely related to neuroticism or anxiety.

Finally, the present findings seem to confirm the results of a more recent study (Anthony, Clark and Anderson, 2000) that found a negative correlation between neuroticism and computer-related attitude and a positive correlation between neuroticism and computer anxiety.

The findings of the present study confirm the more general literature on neuroticism or trait-anxiety suggesting that high trait-anxious individuals (with the underlying personality dimension of neuroticism) would be more prone to any type of state anxiety (e.g. Francis, 1993), including computer anxiety, because of their general fluctuations of mood, negative thinking and negative interpretation of events in their lives, easily hurt feelings and feelings of guilt, irritability and anticipation of the awful, all as described and assessed by the Eysenck's Personality Inventory (1963, 1964, 1975).

3.5. Personality on attitude

Stepwise multiple regressions were also conducted to see which personality dimension carries more weight in predicting computer attitudes and to look at the contribution of personality dimensions to attitude variables. The intention here was to see whether attitudes can be explained by personality characteristics, and thus the effects on stress and performance due to attitudes were really just a

result of personality. In other words, if a) attitude is a result of personality and b) stress is a result of attitudes, then is (b) due to (a)?

For each of the regressions, the dependent variable was one of the following: computer anxiety, computer confidence, computer liking, and general computer attitude.

Levenson's internality and chance, Paulhus' personal and interpersonal control, neuroticism, and extraversion, as well as Broad view of A typology were used as independent variables. These personality variables were selected on the basis of their correlation with the dependent variables.

Neuroticism was the main personality dimension in predicting all attitude dimensions – however, in all cases weakly. Broad view of A typology and personal control played some part in predicting anxiety and confidence respectively.

4. Change of attitude

The present results show that subjects' attitudes towards computers in general did change significantly from the beginning (Test 1) to the end of an academic year (Test 2) as a result of computer training. As measured by the CAS subscales, although computer anxiety did not change significantly, confidence decreased significantly, and liking decreased highly significantly. Attitudes, and in particular computer liking, as measured by the DCAS, also decreased significantly and shifted to be less favourable.

These results were obtained by repeated measures t-tests.

These findings confirm Rosen et al's (1987) study but conflict with the results of other researchers reviewed in the Introduction (e.g. Gressard and Lloyd, 1985; Harrington et al, 1990; Brown and Coney, 1994; and Czaja and Sharit 1998). It also negates Woodrow's (1994) findings, that gains in computer attitudes were independent of computer training. In Woodrow's (1994) view, it is the users' unstructured computer experiences, based on the users' current computing needs (e.g. in word processing), that mainly accounts for the improvement of computer attitudes and reduction of computer anxiety.

5. Prior experience in association with stress, performance and subjective difficulty

Prior experience and stress

An Analysis of Variance (ANOVA), for the four experience groups, on their stress scores **before** computer sessions (as collapsed across four weeks), showed that computing experience prior to this study was a predictor of their initial ('before') stress scores. In particular, a Bonferroni test showed that subjects who have experienced one or more of an advanced range of computer uses (i.e. program development and/or statistical analysis and/or control - as indicated on the first question of the DCAS, Part II), have overall lower initial stress scores than naive computer users or those who have only used computers in 'every day' 'easier' applications (i.e. communications and/or word processing and/or instructional / educational programs). No significant difference in initial stress was found for the 'game players'.

Similarly, an ANOVA, for the four experience groups, on their stress scores **after** computer sessions (each collapsed across four weeks) showed that computing experience prior to this study was a predictor of their final ('after') stress scores. A Bonferroni test showed that 'high' users have overall lower final stress scores than those subjects without any prior computing experience. No

significant difference in final stress was found for those who have only used computers in 'every day' 'easier' applications or for those who only play computer games.

This result indicated that in general the preceding computer tasks were related to similar amounts of stress after sessions for the 'medium' and 'high' users.

In order to assess the effect of prior computer experience on stress frustration, anger, etc, as measured by the subjective ratings (CPTOT), a one-way analysis of variance (ANOVA) was conducted, for the four experience groups, on their subjective ratings scores each collapsed across four weeks. Subsequently, a Bonferroni test was employed.

It was found that scores for group 4 (high users) were significantly different (lower) than those for groups 3 and 2 (medium users and games players respectively). No significant difference was found with the naïve users, possibly due to the small size of the naïve users' group.

This finding is not consistent with the suggestion by Hudiburg (1989a) that the number of hassles and the amount of stress increased with number of hours of computer use and consequently with computer experience. In particular, Hudiburg suggested that the more the experience people have with computers, the more likely they are to experience 'hassles' and negative feelings/moods; and the more the 'hassles' people have, the more likely they will be to score higher on stress. However, this could be regarded as an issue of 'opportunity'. In particular, Hudiburg's experienced users may have encountered more hassles mainly because they use computers more. In the present study, although experienced users seem to have lower levels of stress both before and after computer sessions, however, they do show increased levels of stress over a session more than any other experience group.

The present finding is not consistent with Hudiburg (1990), Balance and Balance (1996), and Dolan and Tziner's (1988) results. Dolan and Tziner (1988) suggested that those with previous experience reported higher levels of experienced stress associated with training and instruction. The present findings also seem to negate Kumashiro et al (1989) and Turner's (1980) studies which suggested that there is no relation between the amount of computer use and psychological strain.

Prior experience and change of stress

The data were collapsed over four weeks for each of the four groups of computer experience. Then, comparisons of pre-session to post-session stress were made by performing repeated measures two-tailed t-tests for each group separately. In addition, the data for high users only were further explored with repeated measures two-tailed tests. These were performed on stress before and after computer interaction and for each of the four weeks separately.

Comparisons of pre-session to post-session stress indicated that post-session stress scores were significantly higher than pre-session stress scores only for the first week of the practicals, and, in particular, only for the first week of the users with high experience.

Although high experience users started with the lowest levels of stress, their stress score was the only one to be increased significantly by the end of the first week's session.

Prior experience and performance

ANOVAs were performed for each of the four weeks, and a one-way ANOVA was then performed between the four 'experience' groups with data collapsed across weeks.

The results showed that there was no effect of computer experience on computer performance, i.e. prior experience did not seem to affect performance.

So, for example, high users do not achieve higher performance scores than naive computer users or those who have only used computers in 'every day' 'easier' applications or games, as somebody may have expected.

There is no way to compare the present result to findings within the literature, since there is no research on the relation between prior computer experience and performance.

Prior experience and subjective difficulty

ANOVAs were performed for each of the four weeks, and a one-way ANOVA was then performed between the four 'experience' groups with data collapsed across weeks. A Bonferroni test was subsequently performed.

There was some effect of computer experience on subjective difficulty, significant only for the second week of the practicals, and due to the 'high' and 'medium' experience groups.

In particular, subjects who for example have experienced at least one of the advanced range of computer uses will have less subjective difficulty than subjects with less prior computer experience; and subjects who have used computers, for example, only for communications and/or word processing will have less subjective difficulty than those subjects who have only played computer games. No significant result on subjective difficulty was shown for subjects with no previous computing experience.

Prior experience and change of attitude

The present results show that initial computer experience did relate to changes of attitudes from Test 1 (at the beginning of the academic year) to Test 2 (at the end of the academic year). Those subjects with greater prior computing experience actually had more/higher attitude changes than those subjects who had relatively less experience. In particular, the high experience group differed significantly from initial to final attitude in confidence and liking, as measured by CAS, and marginally significantly in anxiety (CAS) and attitude as measured by DCAS (mainly computer liking). The medium experience group changed their attitude significantly only for computer liking and DCAS. Games players changed only for liking, and naive users, despite of their change in anxiety, showed no significant shift of attitude, probably because of their sample size.

In the case of naïve users, there may be a slight suggestion that their computer anxiety decreases (and, thus, their attitude improves) from Test 1 to Test 2. Although the absence of significance may be due to their small sample size, this absence makes it difficult to conclude that the naïve group shows a definite improvement of attitude.

These results were obtained by performing Multiple Analysis of Variance (MANOVA) procedures and selected repeated measures two-tailed t-tests.

6. Personality in association with stress, performance and subjective difficulty

6.1. Locus of control in association with stress, performance and subjective difficulty

Locus of control and computer stress

Results derived from correlations indicated that all three variables of computer-related stress ['stress before' and 'stress after' computer sessions, both measured by SACL, and subjective ratings taken after sessions] were significantly correlated with several measures of locus of control (personal and

interpersonal control, as indicated by Paulhus' scales, and internality and chance, as indicated by Levenson's scales).

In view of these findings, it would generally appear that there is a relationship between computer stress and locus of control, in that an individual with an internal locus of control is more likely to experience less stress before and less stress (including anger, frustration, etc) after computer sessions.

There is not a lot of either support or contradiction of this result within the literature, as the relation between locus of control and computer stress has been scarcely dealt with. However, given the inverse correlation of computer attitude and computer stress, the present result seems to indirectly agree with Coovert and Goldstein's (1980) as well as Wesley et al's (1985) findings: Since internals have overall a more positive attitude towards computers than externals, and since more positive attitude has been found to be associated with lower stress levels, then internals should experience lower computer stress levels than externals. In addition and considering the relation between computer stress and anxiety, the present results, in a way, seem to confirm Morrow et al's findings (1986) that higher externality of locus of control is significantly related to higher computer anxiety and stress.

Also, the present result seems to agree with the more general literature on the locus of control construct suggesting that internals would be less prone to stress in general, and computer stress in particular, because of their general confidence in their own ability to control and master challenges (e.g. Payne, 1988; Cooper and Sutherland, 1988; Peck and Whitlow, 1975; Greer et al, 1970; Parkes, 1984; Kobasa, 1988).

However, the present findings seem to negate Syrotnick and D'Arcy's (1982) conclusion that locus of control does not have extensive effects on stress. Also, the present results may indirectly contradict Woodrow's (1990) findings which suggested that externals rather than internals have more positive attitudes towards computers, and thus externals probably rather than internals are more likely to experience lower levels of computer stress.

Locus of control and computer performance

No significant correlations were found between performance and any of the Paulhus' subscales. However, in considering Levenson's subscales, there were two significant (although small) correlations between performance and internality, and performance and 'powerful others'.

In view of these findings, it would generally appear that there is a relationship between computer performance and locus of control, in that an individual with an internal locus of control is more likely to achieve better performance when operating a computer.

This result seems to confirm Wesley et al's (1985) findings that internals overall achieve better performance on various computer tasks than externals. It also goes along with the findings of Horak and Horak (1982), Horak and Slobodzian (1980), Griswold (1983), Chin and Zecker, 1985, and Wesley, Krockover and Hicks (1985).

This result also seems to agree with the more general literature on the locus of control construct suggesting that internals would be more efficient in most activities and perform better on most situations because of their motivation and general confidence in their own ability to control and master challenges (e.g. Cooper et al, 1988; Cooper and Sutherland, 1988; DeSanctis, 1982; Rotter, 1966; Broedling, 1975; Lefcourt, 1972; Phares, 1976; Zmud, 1980). Indeed, Levenson (1973) stated that her 'Internal' scale items are statements that "emphasise the competency of the individual in planning and having his hard work rewarded".

In addition, given the positive correlation of computer attitude and computer performance, the present result seems (indirectly) to go along with Coovert and Goldstein's (1980) as well as

Morrow et al's (1986) findings: Since internals have overall a more positive attitude towards computers than externals, and since more positive attitude has been found to be associated with better performance, then internals should perform better than externals.

Moreover, Hall and Cooper (1991) have confirmed the view that those with a high 'powerful others' external pattern also tend to personify the computer, since they view it more as a 'powerful other' rather than as a machine. The authors found that subjects' essays which described successful episodes while working on a computer were more often written using impersonal references to the computer; whereas essays describing failure episodes contained more personal and intimate terms for the computer. Hence, it may be that those performing worse when interacting with computers may view the computer as a powerful other.

However, the present results seem to contradict Woodrow's (1990) findings which suggested directly or indirectly that externals rather than internals are more likely to perform better in computing. The present results also seem to negate Nowaczyk's (1983) findings that locus of control was not a significant variable in predicting computer programming success, and Wilson, Mundy-Castle and Cutts's (1989) study that reported mixed results on the relation between locus of control and computer programming performance.

Locus of control and subjective difficulty

There was one significant correlation found between subjective difficulty and the Paulhus' interpersonal control subscale. In considering Levenson's subscales, there were two significant correlations between subjective difficulty and 'chance', and between subjective difficulty and 'internality'.

It would appear that there is a relationship between subjective difficulty and locus of control, in that an individual with an internal locus of control is more likely to experience and/or perceive less difficulty when operating a computer.

6.2. Type A in association with stress, performance and subjective difficulty

A Typology and computer stress

The only significant correlation found between A typology and stress was the one between 'Broad view' and subjective ratings. This result indicates that there is some relationship between Type A and computer stress (including relevant to stress constructs, such as anger, frustration, helplessness, etc), in that the higher the Type A pattern, the lower the levels of experienced stress and relevant constructs.

This result seems to contradict Hart et al's findings (1987) that Type As may exhibit more stress than Type Bs when performing various sets of computer tasks. It also contradicts the more general literature on the Type A personality construct suggesting that Type As would be more prone to stress and anxiety (as well as anger, frustration, and helplessness) because of their general competitiveness, achievement striving, time urgency, impatience and hostility (e.g. Kobasa, 1988; Orpen, 1982; Cooper and Payne, 1988; Keenan and McBain, 1979). The present results also indirectly negate Van Dijkhuizen and Reiche's (1980) finding that Type As exhibit more psychological complaints.

A Typology and computer performance

There was no significant association between any of the A Typology variables and performance on computing tasks. This result suggests that an individual's computer performance has nothing to do with their A Typology behaviour pattern.

This result fails to confirm Hart et al's findings (1987) that Type As achieve better performance than Type Bs when performing various sets of computer tasks. It also seems to negate some of the more general literature on the Type A personality construct suggesting that Type As would perform better than Type B's on anything because of their general competitiveness, achievement striving, ambition, higher self-esteem, ever-increasing expectations of personal productivity, commitment, confidence and dedication (e.g. Kobasa, 1988; Chesney and Rosenman, 1983; Cooper, Cooper and Eater, 1988; Van Dijkhuizen and Reiche, 1980; Damos and Bloem, 1985).

A Typology and subjective difficulty

The only A Typology variable found to be significantly associated with subjective difficulty was the 'Broad view of Type A'. This result suggests that a person's experienced difficulty when completing various computing tasks have at least some relation to their A Typology behaviour pattern, in that the higher the Type A pattern the less the difficulty.

The present result may be interpreted as confirming Hart et al's findings (1987) where evaluations given by Type As and Type Bs may not have been equally reflecting and representative of their experiences. In particular, in Hart et al's 1987 study, Type As appeared to be less sensitive to the effort they exerted to achieve their scores. Also, Type As' physical and mental effort was measured and found to be lower; and Type As reported similar levels of fatigue, even though they appeared to have been working harder than Type Bs. Therefore, it seems that Type As tend to underestimate the difficulty they experience while completing a series of computer tasks.

6.3. Extraversion in association with stress, performance and subjective difficulty

Extraversion and computer stress

There was a significant association between extraversion and stress experienced before computer sessions, in that the higher the levels of extraversion, the lower the levels of 'stress before'.

There is no way to compare the present result to findings within the literature, since there is no research on the relation between extraversion and computer stress.

Extraversion and computer performance

There was no significant association between extraversion and performance. This result indicates that a person's performance is probably independent and irrelevant to their levels of extraversion.

Although the difference in the computer activities involved, the present result seems to be consistent with research that found no relation between extraversion and computer programming achievement or success (e.g. Chin and Zecker, 1985; Kagan and Douthat 1985; Newsted 1975). However, the present finding seems to contradict research that found a negative relation between extraversion and computer programming achievement (e.g. Kagan and Esquerra, 1984).

Also, the present results seem to contradict some of the more general literature that found a significant difference between introverted and extraverted students in actual performance (e.g. Kim,

1980) - and negate research that found introverted students to have greater examination success than extraverted students (e.g. Wankowski, 1973).

Moreover, a possible assumption, that the introverts' personality characteristics (for example, being quiet, reserved, tidy-minded, well ordered and well organised) may affect positively their computer performance, was not upheld.

Extraversion and subjective difficulty

No correlation was found between extraversion and subjective difficulty. This suggests that a person's experienced difficulty during completion of several computer tasks does not relate to their extraversion personality trait.

6.4. Neuroticism in association with stress, performance and subjective difficulty

Neuroticism and computer stress

There were two significant correlations between neuroticism and stress before and stress after computer sessions (both measured by SACL). There was also a significant correlation between neuroticism and the subjective ratings.

These results suggest that a person's experienced stress when conducting computer sessions have a close relation to their personality characteristic of neuroticism, in that the higher the neuroticism the more the individual is likely to experience stress before, during and after computer sessions.

There is no way to compare the present result to findings within the literature, since there is no research on the relation between neuroticism and computer stress.

Neuroticism and computer performance

There was no significant association between neuroticism and performance on computing tasks. This result suggests that a person's computer performance has nothing to do with their neuroticism personality characteristic.

There is no way to compare the present result to findings within the literature, since there is no research on the relation between neuroticism and computer performance.

Neuroticism and subjective difficulty

There was a small but significant correlation between neuroticism and subjective difficulty. Thus, a person's experienced difficulty during completion of several computer tasks does weakly relate to their neuroticism trait, in that the higher the levels of neuroticism the lower the difficulty.

6.5. Personality and attitude on stress, performance and subjective difficulty

Moreover, stepwise regressions were conducted to see whether personality variables (i.e. locus of control, Type A, neuroticism, and extraversion) add or contribute anything to the variance of computer stress and performance over and above computer attitudes.

Thus, multiple regression analysis was conducted to look at the contribution of the personality and attitude variables to the outcome. For each of the regressions, the dependent variable was one of the

following: performance, subjective difficulty, 'stress before' computing sessions, 'stress after' computing sessions, or the subjective ratings indicating stress, frustration, anger, etc, during and after computer sessions.

The independent variables for each of the regressions were some of the dimensions of each of the locus of control scales (Levenson's Internality and Chance, and Paulhus' Personal and Interpersonal control), neuroticism, and extraversion, 'Broad View' of Type A, and the attitude dimensions of computer anxiety and confidence.

The personality variables were selected on the basis of their correlation with the dependent variables, and their representative power of the measure to which they belong. The attitude variables were selected on the basis of their correlation with the dependent variables. Also, computer confidence was selected for its primarily strong significant contributions in previous regressions, and computer anxiety in an attempt to find out the extent to which computer anxiety could predict the dependent variables (seen as an important and interesting question).

a. Performance

The best predictors of performance were found to be personality variables (i.e. internality and to a lesser extent chance) – although even these variables accounted for only a small proportion of variance.

b. Subjective difficulty

Both attitudes and personality were found to contribute to the difficulty experienced when completing computer tasks, with attitudes (computer confidence, in particular) being a much stronger predictor than personality (chance, in particular).

c. Stress before

Both attitudes and personality were found to contribute to stress experienced before computer sessions, with attitudes (computer anxiety) being a stronger predictor than personality (neuroticism).

d. Stress after

Mainly attitude, and in particular computer confidence, were found to contribute mostly to stress experienced after computer sessions. The personality variables of neuroticism and locus of control (in particular, chance) were found to be much weaker predictors of 'stress after'.

e. Subjective ratings

Again attitude, and in particular confidence, was found to contribute mostly to subjective ratings. Locus of control, and in particular interpersonal control and internality, were found to be much weaker predictors of subjective ratings.

f. Experience, personality and attitude on stress and performance

When the 'experience dummy variable' was added to the independent variables, it was found that experience had a small effect in predicting only stress before computer sessions. Experience was not found to have an effect on computer performance.

[Reminder: Within this context, computer experience was expressed as a dummy variable that contrasts the 'high experience' group with all others. (The 'high' group was the only group that significantly differed from all others on initial computer attitude as well as on change of attitude as a result of a computing course)].

In summary, the main results of the regressions are:

1) Computer confidence is the main and strong predictor variable in determining subjective ratings, the main variable in predicting 'stress after', the key variable in predicting subjective difficulty, and

a contributing variable in predicting performance. It is only where the dependent variable is 'stress before' that computer confidence does not contribute anything to the outcome. 2) Computer anxiety is the key predictor of 'stress before'; however, it does not add anything to the variance of any other dependent variable. 3) Levenson's internal locus of control is the main, although weak, predictor of performance, and slightly contributes to the outcome of subjective ratings. 4) Levenson's 'chance' is a major but weak predictor of performance, and slightly contributes to subjective difficulty and 'stress after'. 5) Neuroticism is a considerable contributor to the outcome of 'stress before', and accounts for a small proportion of the variance of 'stress after'. 6) Paulhus' interpersonal control slightly contributes to the outcome of the subjective ratings.

References

References are provided either at the 'References' section of the thesis (pp 212-235) or at the end of Appendix Thirteen (pp 278-281).

